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# Comer Debris Basin
# Engineering Feasibility Study
# Final Report

18 April 2002

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K/J Project No. 015014.00

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# Section 1: EXECUTIVE SUMMARY

## 1.1 Project Background

The Comer Debris Basin is located on Calabazas Creek in Santa Clara County, as shown on Figure 1.1. The Santa Clara Valley Water District (District) constructed the basin in 1973 as a sediment collection facility consisting of a 12-foot high dam located approximately 300 feet downstream of the Comer Drive bridge. The basin operated as a debris removal facility until 1992, when the District ceased maintenance operations to remove accumulated debris. The basin was allowed to fill after 1992, resulting in a reduction of clearance between the channel bottom and the Comer Drive bridge from 10 feet to approximately 4 feet. Currently, the basin is characterized by an exposed surface of coarse sediment and little vegetation; debris and sediment flow through the basin and continue downstream.

This project was initiated by the District's West Watershed Operations Division at the request of the North Central Zone Advisory Committee and a member of the City of Saratoga City Council.

## 1.2 Project Objective and Scope of Work

The scope of work is to conduct a preliminary evaluation of existing conditions at the Comer Debris Basin along with three additional basin modification/removal alternatives to assess hydraulic, sediment transport, environmental, and aesthetic impacts of these alternatives on Calabazas Creek.

The objective of the Comer Debris Basin Engineering Feasibility Study is as follows:

- Evaluate the feasibility of removing/modifying the basin.

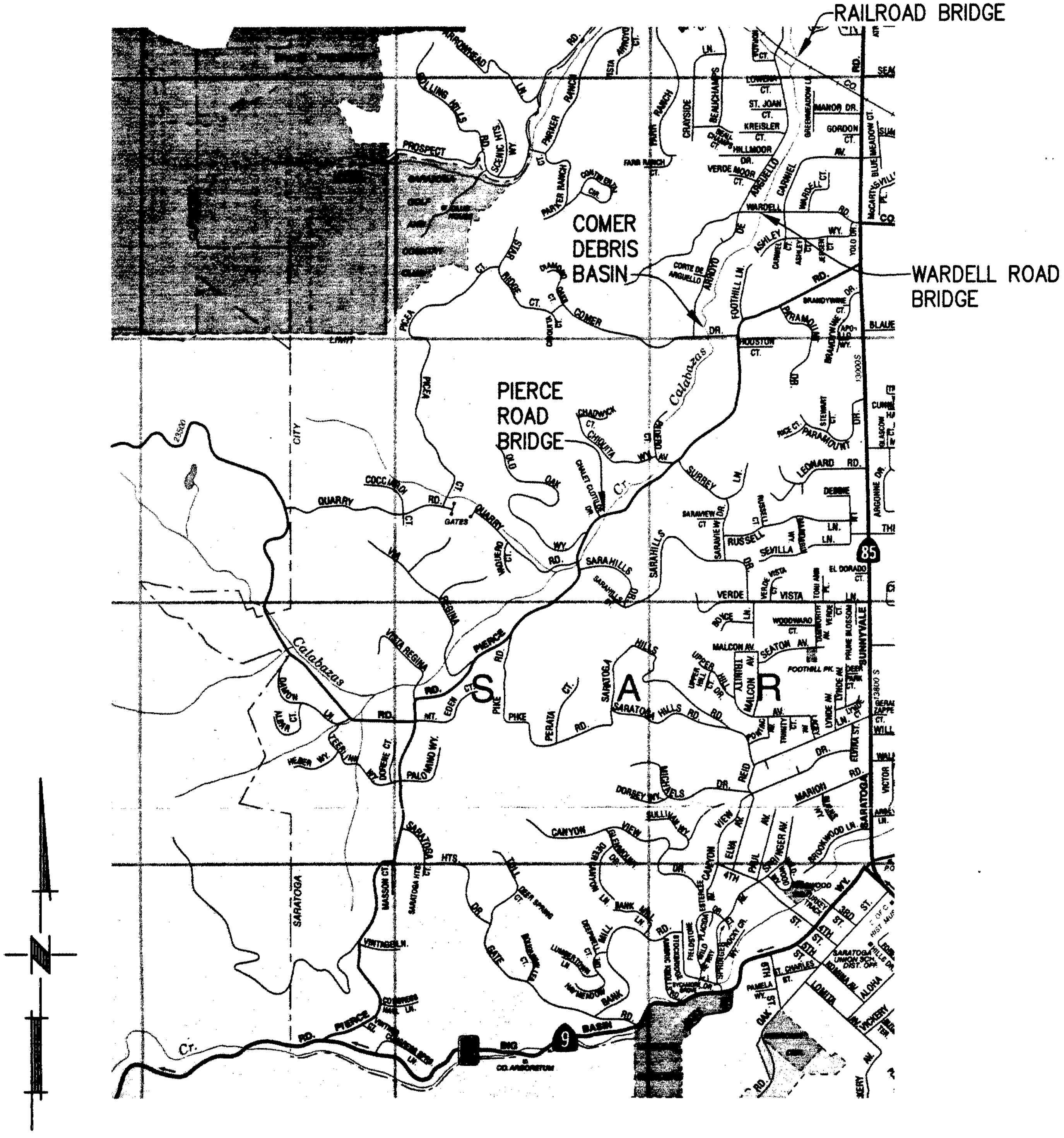
The District anticipates that the feasibility study is to be part of the development of a long-term plan for the watershed. The feasibility study is needed to ensure that the watershed plan includes information regarding the effects of the basin on sedimentation, environmental restoration, environmental enhancements, maintenance requirements, and repair of facilities.

## 1.3 Alternatives Considered

The study evaluated the following alternatives:

Alternative 1 – Existing conditions are included for evaluation of a "no action" alternative.

Alternative 2 – This alternative involves removing the entire concrete basin dam and wingwalls. Restoration would involve excavating existing basin sediment to establish a uniform stream channel slope to a distance of approximately 1,300 feet upstream of the Comer Drive bridge.



SCALE: 1"=2100'

SOURCE: AAA
SUNNYVALE MAP
1998

Kennedy/Jenks Consultants

SANTA CLARA VALLEY WATER DISTRICT
COMER DEBRIS BASIN

**FEASIBILITY STUDY**
**LOCATION MAP**

K/J 015014.00
FEB 2002

**FIGURE 1-1**

Alternative 3 – This alternative also involves removing the entire basin dam and wingwalls. Existing basin sediment would be excavated to construct a stream channel profile that would be "stepped" to form shallow pools and small falls. Excavation of channel sediments would extend approximately 500 feet upstream of the Comer Drive bridge.

Alternative 4 – This alternative involves removing the upper 3 feet of the basin dam headwall and leaving the existing retaining walls. Existing basin sediment would be excavated to a depth 3 feet below the existing basin surface elevation; sediment excavation would extend approximately 50 feet upstream of the Comer Drive bridge, where a channel step would be constructed upstream of Comer Drive to match to the existing channel bed. Channel stabilization and revegetation would be conducted using the same methods and materials specified for Alternatives 2 and 3.

## 1.4 Evaluation

A comparative evaluation of basin removal/modification alternatives and existing conditions was conducted to assess whether removing or modifying the basin would constitute a benefit to the District. The evaluation of alternatives was conducted using the following steps:

- Develop a set of constraints, which will dictate evaluation criteria for comparing three alternatives to existing conditions.
- Assess the qualitative impacts to environmental, biological, and aesthetic factors resulting from removal or modification of the basin.
- Conduct screening level modeling of hydraulics and the sediment transport regime to identify potential impacts to flood conveyance capacity and/or sediment transport characteristics resulting from the removal or modification of the basin.

## 1.5 Project Results

The study results indicate the following:

- Sensitive species habitats were not observed in the immediate vicinity of the Comer Debris Basin.
- If an alternative to existing conditions (i.e., to no action) is selected, there is a need for wetlands delineation as part of any future design effort.
- Impacts to habitat and the surrounding neighbors will be short-term and limited to the construction period. The impacts from Alternative 2 will be substantially greater than for Alternatives 3 and 4, since construction must proceed approximately 1,300 feet upstream of the Comer Drive bridge. Alternative 3 will result in construction impacts up to 500 feet upstream of Comer Drive, and Alternative 4 will result in construction disturbance between 50 and 100 feet upstream of the bridge.

- Alternatives 2, 3, and 4 would alleviate the existing potential for flooding at the Comer Drive bridge for the 100-year event. The alternatives have no impact on other potential flood areas on Calabazas Creek.

- Alternatives 2, 3, and 4 will each provide for the creation of between 300 and 400 feet of shaded riverine aquatic (SRA) habitat in the stream channel to link the SRA habitat that currently exists immediately upstream and downstream of the Comer Debris Basin. Alternative 1 does not offer significant opportunities to create SRA.

- Alternatives 2, 3, and 4 will each provide for the creation of an additional ½ acre of native upland vegetation in the location of the former debris basin, which will offer additional terrestrial habitat opportunities.

- Alternative 3 will provide for improved aquatic habitat opportunities during the wet season through the formation of two ephemeral pools in the stream channel, each with an estimated area of approximately 1,600 $ft^2$. This alternative would also result in desirable aesthetic improvements through the formation of a series of small falls and pools.

- Alternative 4 would leave approximately 9 vertical feet of the existing basin dam headwall in place, which would detract from the aesthetics of the restored stream channel.

- Alternative 4 would require restoration of portions of the retaining walls on either side of the basin dam headwall. It is expected that removal of the upper 3 feet of the dam headwall would expose soil beneath the retaining walls at the demolished ends of the headwall. Additional concrete and reinforcing steel would be required to stabilize the walls for subsequent exposure to winter storm flows.

- Alternatives 2, 3, and 4 can be optimized during a future design effort to identify a stable channel configuration, which is a function of both the channel slope and width.

- Preliminary estimates of probable costs are summarized as follows:

| Alternative | Design & Construction Cost | Annual O & M Costs |
|---|---|---|
| 1 | No additional cost to District | No additional cost to District |
| 2 | $1,250,000 | $14,500 |
| 3 | $890,000 | $20,000 |
| 4 | $590,000 | $14,500 |

# Section 2: PROJECT BACKGROUND AND REVIEW OF AVAILABLE DATA

## 2.1 Project Background

The Comer Debris Basin is located on Calabazas Creek in Santa Clara County, as shown on Figure 1.1. The Santa Clara Valley Water District (District) constructed the basin in 1973 as a sediment collection facility consisting of a 12-foot high dam located approximately 300 feet downstream of the Comer Drive bridge. The basin operated as a debris removal facility until 1992, when the District ceased maintenance operations to remove accumulated debris. The basin was allowed to fill after 1992, resulting in a reduction of clearance between the channel bottom and the Comer Drive bridge from 10 feet to approximately 4 feet. Currently, the basin is characterized by an exposed surface of coarse sediment and little vegetation; debris and sediment flow through the basin and continue downstream.

This project was initiated by the District's West Watershed Operations Division at the request of the North Central Zone Advisory Committee and a member of the City of Saratoga City Council.

## 2.2 Project Objective and Scope of Work

The scope of work is to conduct a preliminary evaluation of existing conditions at the Comer Debris Basin along with three additional basin modification/removal alternatives to assess hydraulic, sediment transport, environmental, and aesthetic impacts of these alternatives on Calabazas Creek.

The objectives of the Comer Debris Basin Engineering Feasibility Study are as follows:

- Evaluate the feasibility of removing/modifying the basin.

The District anticipates that the feasibility study is to be part of the development of a long-term plan for the watershed. The feasibility is needed to ensure that the watershed plan includes information regarding the effects of the basin on sedimentation, environmental restoration, environmental enhancements, maintenance requirements, and repair of facilities.

## 2.3 Available Data

Data provided by the District for this study are listed in Table 2.1 and are summarized below. References to item numbers refer to Table 2.1.

### 2.3.1 Hydrology

In the context of this feasibility study, items 1, 6, and 8 provided information regarding the hydrology of Calabazas Creek. In addition, on 6/12/01, the District provided the Calabazas Creek flow estimates for the 10-year and 100-year return interval flows for use in the U.S. Army Corps of Engineers Hydrologic Engineering Center – River Analysis System (HEC-RAS) model described in Section 2.1.2. The flows are estimated to be 580 cubic feet per second (cfs) for the 10-year return interval event and 1,180 cfs for the100-year return interval event. The District also indicated that the estimated flow volume for the 2.3-year event was 220 cfs.

### 2.3.2 Hydraulics

Items 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 provided the information that was used to develop and update the HEC-RAS model for Calabazas Creek.

- Item 7, consisting of updated survey data provided in 2001 by District survey staff, was used to modify the HEC-2 model input files identified in Item 9, which were based on 1978 survey data.
- Item 11, consisting of stream channel profiles through Comer Basin, were dated 1971 and were assumed to be the pre-dam-project profiles.
- Item 12 consists of the as-built drawings for the Comer Debris Basin, dated 1974.
- Item 13, consisting of channel profiles from Mt. Eden Road to the Wardell Road bridge, are identified as being based on aerial photographs dated May 1974.
- Item 14, consisting of channel profiles from Comer Drive to Saratoga-Sunnyvale Road, are described as being based on a March 1987 aerial photograph, but these profiles appear to represent pre-dam-project conditions.
- Item 15, consisting of a profile from Miller Avenue to Comer Drive, is assumed to be based on 1992 aerial photographs.

A summary of historical profiles for the immediate vicinity of the debris basin is provided in Appendix A along with other data items supplied by the District. It was assumed that all of the plans and profiles provided by the District were on a common vertical datum of National Geodetic Vertical Datum 1927 (NGVD–27) and a common horizontal datum of North American Datum 1983 (NAD-83). No common sequence of channel cross-section station numbers was used in the various HEC-2 model input files supplied by the District. The HEC-RAS model for this feasibility study was developed using a cross section station numbering system specific to the model.

### 2.3.3 Sedimentation

Items 4 and 6, listed in Table 2.1, provided the sedimentation data used in this feasibility study. Item 4 (found in Appendix A) provided limited maintenance records summarizing when the Comer Debris Basin was cleaned out between 1978 and 1992. There has been no maintenance of the basin since 1992. The available sediment data provides a gross relative measure of the sediment accumulation in the Comer Debris Basin. It provides no information on the sediments that have passed through the basin after 1992.

## Table 2.1
## Document Summary
## Santa Clara Valley Water District
## Comer Debris Basin Feasibility Study

| | Description | Type | Source | Date | Comments | Survey Datum for Plans |
|---|---|---|---|---|---|---|
| 1 | 100-yr flood plain mapping along Calabazas Creek | hard-copy | SCVWD | rec'd May 2001 | No 100-yr flood studies of Comer Debris basin have been done | not applicable |
| 2 | Biological/environmental assessments GIS maps on Calabazas Creek | hard-copy | SCVWD | rec'd June 2001 | Potential red legged frog habitat area | not applicable |
| 3 | Board Governance Policy (GP-1) for Santa Clara Valley Water District | hard-copy | SCVWD | adopted 10/19/99 | Describes watershed stewardships goals. | not applicable |
| 4 | Maintenance Records for the Comer Debris Basin | hard-copy | SCVWD | rec'd May 2001 | Listing of Debris basin maintenance by year and estimated volume | not applicable |
| 5 | Figure 3 - Calabazas Creek Bed Profiles | hard-copy | none cited | rec'd May 2001 | Comparison of 1972, 1974, and 1987 bed profiles | not cited |
| 6 | Interim Report on Streamflow, Sediment Discharge and Water Quality in Calabazas Creek Basin, Santa Clara County, California (Water-Resources Investigation 78-2) | hard-copy | USGS/SCVWD | 1978 | Limited particle distribution data | not applicable |
| 7 | Survey data | spreadsheet + ACAD files, hard-copy field notes | SCVWD | Winter 2000 - 2001 | At locations specified by K/J, (0101t&g.xls, sections.xls, 0101t&g.asc, sheet1.dwg, sheet2.dwg) | NGVD 27- V, NAD 83- H |
| 8 | Stream gage data along Calabazas Creek | spreadsheet/ text files | SCVWD | 1945 - 2000 | Daily gage values from at Station 1477- Calabazas Creek at Wilcox, also 26a- assumed to be same station 1477. 1945-1992.xls, Sf26a93 99.txt, 1477.txt | not applicable |
| 9 | HEC-2 model input files for Calabazas Creek | model files | SCVWD | 1978 | From a 1978 Planning Study-<br>cal_6.dat from 52+362 (Rainbow Ave dowsntream of 85) to 340+75 (near 280),<br>cal_7.dat - from 52+562 (Rainbow Ave) to 58+462 (Wardell Rd),<br>cal_8.dat - Comer Drive @ 590+00 upstream to 696+96 | not provided |
| 10 | Calabazas Creek Planning study (Guadaloupe Slough to Miller Avenue) consisting of combined Engineer's Report and Final Environmental Impact Report | hard-copy | SCVWD | Feb-94 | Describes flooding far downstream along Calabazas Creek | not applicable |
| 11 | Profile from Stations 7+00 to 13+00 (Soffit of exist. Bridge is at 12+90) | 2 hard-copy plan sheets | SCVWD | 1971 | Assumed to be pre-project profile. No cross-sections or detailed topography is provided | None shown |
| 12 | As-built drawings of Calabazas Sediment Control Facility from Comer Drive Bridge to approximately 400 feet downstream | 10 hard-copy sheets (complete project) | SCVWD | Jan-74 | | None shown, Sheet 8 shows BM as MH on Comer Drive |
| 13 | From Mt. Eden Rd (45+00) to Comer Drive (152+00) to 176+30. labeled Project No. 2010 . | Sheets 5, 6, 7, and 8 of 17 and sheet 4 of 7 | SCVWD | Based on May 1974 aerial photo | Includes profile and Sheet 4 of 7 is topography on 10' contours and spot elevations on Comer Drive only | None shown |
| 14 | Profile from Saratoga-Sunnyvale Road (527+00) to Comer Drive (595+90-upstream face of bridge). | Sheets 10- 15 | SCVWD | Based on March 1987 aerial photo | Includes profile only. No topography. Profile extends downstream of RR tracks (549+40, elev 310' (approx)) | None shown |
| 15 | Profile from Miller Avenue (400+53) to Comer Drive (595+90) | Hard-copy Sheets 1 – 15 | SCVWD | Assumed to be based on 9/1/1992 aerial | Includes profile only. No topography. Profile extends downstream of RR tracks (549+40, 311.3' (approx)) | None shown |
| 16 | Preliminary Environmental Impact Report relative to Flood Control Improvements on Calabazas Creek at Comer Drive, North Central Zone, Project No. 20010, Box No. 0875 | hard-copy | SCVWD | Aug-72 | Brief discussion of environmental impacts and concerns of neighbors | not applicable |

Item 6 is an Interim Report prepared by the U.S. Geological Survey in 1978 [Ref. 1], and it can also be found in Appendix A. While this report provides gross sediment loads for the Calabazas Creek system sufficient for this feasibility study, it does not provide sieve analysis data that could be used in a more detailed design effort. For the purposes of this study, it has been assumed that the sediment regime has not changed substantially since 1992.

### 2.3.4 Environmental Biology and Wildlife

The District supplied information on biological and wildlife resources in the area in the form of a plot from the District's Geographic Information System (GIS) for possible red-legged frog habitat; a copy of this plot is provided in Appendix A. Based on this limited information, the red-legged frog does not appear to occur in the immediate vicinity of the Comer Debris Basin. Further environmental biology and wildlife information were collected during the field visits described in Section 3 below.

### 2.3.5 Other Information

The other information received from the District includes Board Governance Policy GP-1, adopted on 10/19/99, which provides a general description of the policies of the District, including Policy Nos. 4 and 5, which are relevant to the Comer Debris Basin project, as follows:

- GP-1, No. 4: To secure the health, safety, and quality of life in Santa Clara County, the District will carry out a prudent flood management program that reduces the potential for flood damage, balances costs and benefits (including possible environmental restoration and enhancement), and comprehensively addresses the expectations of the community.

- GP-1, No. 5: The District is the steward of the watersheds in Santa Clara county, the streams and the natural resources therein, and will strive to ensure their benefits to the community's quality of life are protected and when appropriate, enhanced or restored. Consistent with the District's primary responsibility to provide for public health and safety, water quality, and water supply, the District's approach in flood management and the water utility shall reflect an ongoing commitment to conserving the environment as a priority in the District's mission of comprehensive public service.

# Section 3: SUMMARY OF CONSTRAINTS ANALYSIS

A constraints analysis was conducted to develop a set of constraints, which were used to determined the evaluation criteria for comparing three basin removal/modification alternatives to existing conditions.

## 3.1 Purpose of Constraints Analysis

The purpose of this task was to provide a screening-level identification and description of the physical, technical, environmental, regulatory, socio-economic (public interest), and legal issues or constraints that would need to be addressed if the Comer Debris Basin were to be modified or removed. Preliminary constraints were identified in the project scope of work. Additional constraints were identified and detailed during three field visits to the project site, which are described in greater detail below. Thomas Reid Associates (TRA), Palo Alto, a specialist in environmental documentation and biological issues, was added to the consulting team specifically to address environmental and biological issues.

## 3.2 Description of Existing Conditions

The present conditions of the area in and around the debris basin are summarized as follows:

- The debris basin is full and the sediment has filled the stream channel under Comer Drive bridge such that there is approximately 3- to 4-feet of clearance under the bridge.

- The toe of the dam/energy dissipator structure is exposed. The rock that was originally placed there, as shown in the basin design drawings, was scoured out during the first season of basin operation.

- There is a shallow surface channel through the existing sediments of the debris basin.

- As evidenced by small pools upstream and downstream of the debris basin, there appears to be some subsurface flow through the sediments of the debris basin during the year.

- Calabazas Creek supports a wildlife population in the area of the debris basin that includes deer, raptors, other birds, and some amphibians.

## 3.3 Summary of Meeting Discussions

### 3.3.1 Summary of Field Visit No. 1 – 28 June 2001

The purpose of field visit No. 1 was:

- To discuss the benefits and constraints of removing or modifying the debris basin and associated sediment buildup,

- To discuss potential environmental impacts and benefits associated with the alternatives that are discussed in greater detail in Section 4 of this report, and

- To review the California Environmental Quality Act (CEQA) Initial Study checklist and to identify potential impacts as described by CEQA for a project.

As described in a 5 July 2001 letter report (see Appendix B), TRA recommended a follow-up visit by a qualified biologist to determine potential biological impacts and benefits associated with the removal/modification of the debris basin. The follow-up visit occurred on 20 July 2001 and is described in Section 3.3.2, below.

Using the CEQA Initial Study checklist, the major potential non-construction-related (i.e. long-term) impacts and constraints associated with the project include:

- Potential aesthetic impact if trees are removed,

- Potential presence of special status species and the impacts of the removal/modification of the debris basin on those species,

- Potential water quality impacts if the sediment regime changes,

- Potential erosion and slope stability issues, and

- Potential changes to hydrology/hydraulics.

In addition, a juvenile Cooper's Hawk was sited during this site visit. Construction activities will have to be planned to minimize impacts to species of special concern such as the Cooper's Hawk, primarily during nesting season.

The potential environmental benefits of dam removal and site modification would be associated with the establishment of riparian and native upland vegetation, including improvement of aesthetics and wildlife habitat. Additional discussion of the potential benefits of removing/modifying the debris basin is provided in Section 3.5, below.

### 3.3.2 Field Visit No. 2 – 20 July 2001

The purpose of this field visit was for the TRA biologists to evaluate the debris basin area for the presence of special status species and for other constraints/benefits to the removal or modification of the debris basin. In summary, the findings of the field visit were:

- A wetland delineation would have to be performed prior to the removal of the dam and wing walls as part of the U.S. Army Corps of Engineers (USCOE) permitting process,

- The pools that are found both upstream and downstream of the debris basin are relatively shallow and contained Pacific chorus frog tadpoles,

- Care should be taken to restore stream banks to protect several live oaks in the area if the removal or modification of the debris basin occurs,

- There are several short-term potential negative effects that could be mitigated, such as
    - Increased erosion if stream velocities are expected to increase in the restored portion of the creek,
    - Impacts to the creek channel and nesting raptors from construction machinery during sediment removal, and
    - The response of the sediment transport characteristics of the creek following the removal of sediments necessary to restore the original (i.e., pre-dam) channel slope.
- District staff have not observed any special status species, such as the California tiger salamander, the California red-legged frog, the western pond turtle, and the foothill yellow legged frogs, in the debris basin area. This observation was confirmed by TRA biologists.

### 3.3.3 Field Visit No. 3 – 19 September 2001

The purpose of this field visit was for Kennedy/Jenks staff to develop a qualitative understanding of the hydraulic and sediment characteristics of Calabazas Creek between the Pierce Road bridge and the Union Pacific railroad bridge. The field visit included meeting with residents that have lived adjacent to the creek since the early 1960s, hiking in the stream channel from the railroad bridge upstream to the Pierce Road bridge, and meeting with District staff. Observations from this field visit include:

- There is no distinct evidence of active erosive downcutting of the creek bed downstream of the Comer Debris Basin dam.
- There is some evidence of active bank erosion and stream meander upstream of Comer Drive.
- The sediment visible on the channel bed appears to range in size from sand to cobbles up to 12 inches in diameter. This distribution appears to be relatively uniform along the observed stream reach. In the vicinity of the Comer Drive bridge, the sediment has a pavement-like appearance (see photo in Appendix H).
- There is no visible evidence that flooding of the bridge deck has occurred recently (i.e., within the past 5 years) at the Comer Drive or Wardell Road bridges.
- A mature buck and two does were observed foraging in the upstream portion of the stream reach.

### 3.3.4 Public Workshop No. 1, 21 August 2001

The purpose of this workshop was to inform the public of this feasibility study regarding the potential removal or modification of the debris basin. The workshop started with a presentation of history of the debris basin, the alternatives being explored, the constraints to the project, and the process that was to be followed for the preparation of this feasibility study. Minutes from this workshop are provided in Appendix C.

The public's comments in response to the presentation were mixed. Some attendees were satisfied to leave existing conditions unchanged while others were concerned about District resources being committed to this study rather than using those resources on erosion control projects.

No clear consensus was discernible from the public comments. However, the majority of property owners did indicate that they wanted to see an alternative evaluation and recommendation that did not lead to property damage from construction or new erosion.

### 3.3.5 Public Workshop No. 2, 10 December 2001

The purpose of this workshop was to inform the public of the findings of the feasibility study; minutes are provided in Appendix D.

The workshop started with a presentation summarizing the project background, the identified alternatives, the evaluation criteria, and the study findings. Attendees offered comments on the presentation, expressing the concern that any project that is identified as a result of the study should not result in further erosion damage to property adjacent to the creek.

### 3.3.6 City of Saratoga Council Meeting, 6 March 2002

Public comments were received prior to and during the City of Saratoga Council Meeting held 6 March 2002 regarding the removal/modification of Comer Debris Basin. Copies of these comments are provided in Appendix E along with excerpts from the meeting minutes.

## 3.4 Summary of Constraints

Based on the field visits and discussions within the project team, the following constraints have been identified.

### 3.4.1 Physical/Engineering/Structural/Construction

- Review of the project plans by a structural engineer indicates that removal of only the dam structure would most likely result in inadequate support of the wing walls, one of which provides protection to the existing live oak tree from creek flows. Therefore, to protect the oak tree, either: a) the entire structure should remain in place, b) the wing wall will have to be supported or c) the entire structure should be removed and other, more aesthetic protection should be provided for the oak tree.

- Removal of the sediments and the demolition of the structures will have short-term negative impacts to the area of dust, noise, and construction traffic. These impacts can be mitigated and will have to be addressed during the preparation of the CEQA document for this project.

### 3.4.2 Environmental/Biological

- The presence of the juvenile Cooper's Hawk indicates that construction should be planned to accommodate the nesting season of the hawk and other birds.

- A wetlands delineation should be done in the project area for the USCOE permitting requirements (discussed below in Section 3.4.3).

- A CEQA document will be necessary prior to construction of the project; see Section 3.4.3.

### 3.4.3 Permitting and CEQA Compliance

Permits for the construction of this project would most likely be required from USCOE, San Francisco Bay Regional Water Quality Control Board (SFRWQCB), and the California Department of Fish and Game (CDFG). The permits and their interaction with CEQA are described below.

- The USCOE has jurisdiction over projects involving the addition of soil fill (either temporary or permanent) to waters of U.S. In addition, construction of this project will most likely be addressed under the COE Nationwide Permit No. 27 for Bank Stabilization, Riffle and Pool Restoration, which does not have a minimum size threshold. Permitting under Nationwide Permit No. 27 would require wetlands delineations before and after construction. If requested by the COE, the U.S. Fish and Wildlife Service and National Marine Fisheries may review the project. It is recommended that consultation with USCOE staff occur early in the design process.

- Permits would be required from other agencies, including the SFRWQCB for a water quality certification or waiver, and CDFG.

- CDFG will issue a Streambed Alteration Permit for any construction within the stream channel.

- The project would require the preparation of a CEQA Initial Study, which may lead to a negative declaration or a mitigated negative declaration.

## 3.5 Identification of Potential Benefits

Based on TRA's summary of environmental issues (see Appendix B), the potential long-term environmental benefits of a project to modify or remove the Comer Debris Basin and restore the stream channel in that part of the creek could include the following:

- Formation of at least two ephemeral pools with an estimated area of approximately 1,600 $ft^2$ each. The combined pool area would be larger than has been currently observed at the debris basin dam.

- Restoration of the area upstream of the debris basin with riparian vegetation to potentially provide between 300 and 400 feet of new SRA habitat

- Addition of approximately ½ acre of native upland vegetation and habitat.

A benefit considered by TRA was the removal of a barrier to fish migration in the basin area. Anecdotal information collected from long-time residents living adjacent to Calabazas Creek suggested that fish were present in Calabazas Creek within the last 50 years. However, the

District has no records that corroborate this anecdotal information, particularly in the upper stream reaches where the stream is ephemeral. Consequently, benefits associated with the restoration of fish migration paths have not been included in this feasibility study.

Another potential benefit identified by TRA was improved recreational value of the creek in the basin area following removal of the basin headwall. This potential benefit has not been evaluated in the current feasibility study. If future design work is performed for basin modification/removal, potential recreational benefits will be evaluated at that time to determine if they are compatible with the City of Saratoga Parks and Trails Master Plan and other applicable regional planning documents.

# Section 4: Summary of Alternative Analysis

A comparative evaluation of basin removal/modification alternatives and existing conditions was conducted to assess whether removing or modifying the basin constitutes a benefit to the District. To assess the feasibility of removing the Comer Debris Basin, three alternatives were compared with existing conditions for impacts on channel hydraulic performance as well as on possible changes to the current transport characteristics of stream sediment. This section summarizes the approach and results of the analysis.

## 4.1 Description of Alternatives

Three alternatives to existing conditions were identified for this feasibility study in consultation with the District. Preliminary sketches of these alternatives are provided in this report section.

Alternative 1, which is shown in Figure 4.1, consists of existing conditions.

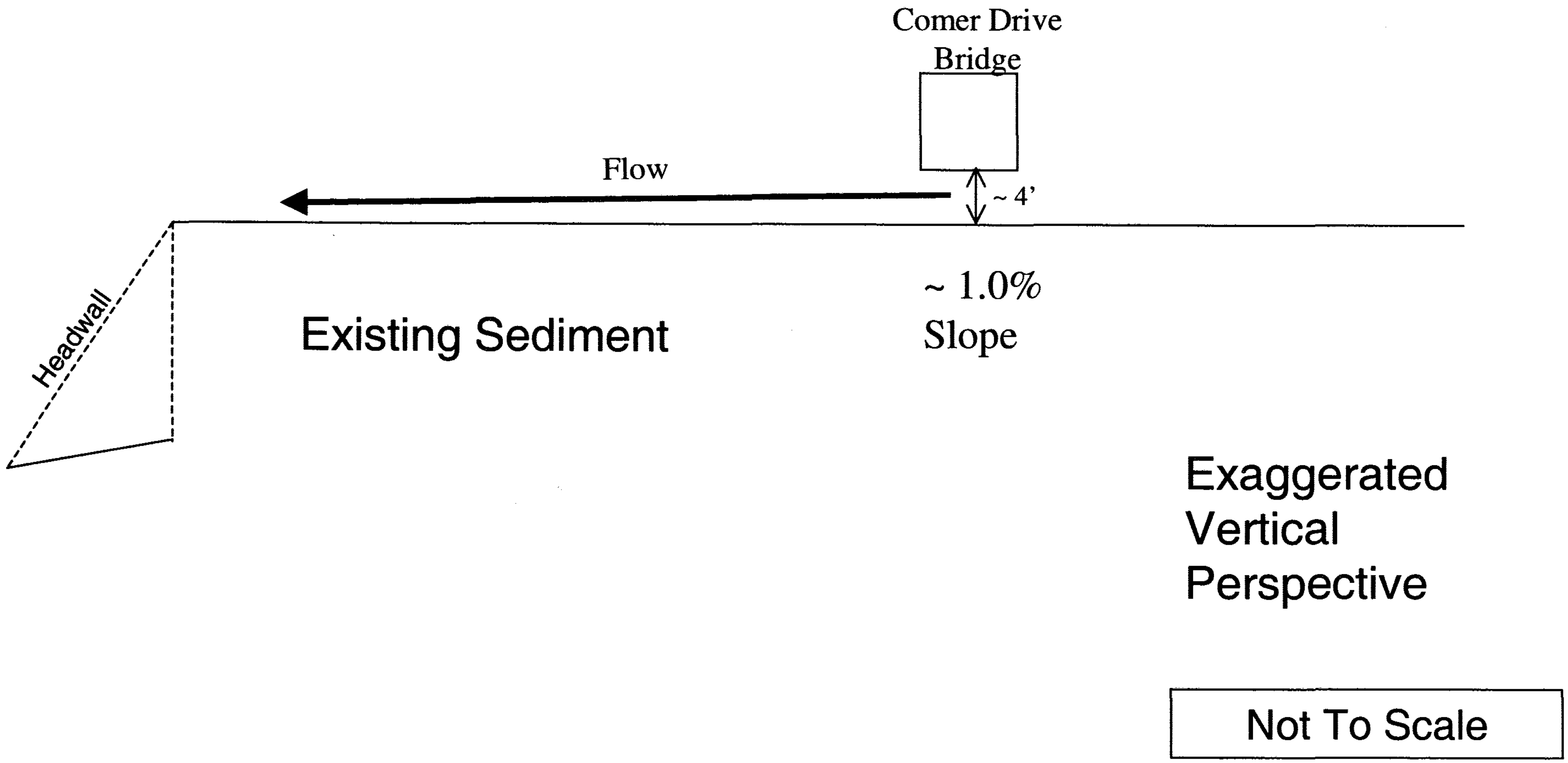
Alternative 2 is shown in Figures 4.2, 4.3, and 4.4, and involves the following:

1. Demolish and remove the existing Comer Debris Basin dam, including retaining walls and wingwalls.
2. Excavate the existing sediment behind the basin dam to a width to match the existing stream channel width both upstream and downstream of the basin.
3. Excavate the existing basin sediment to create a channel slope that matches the pre-dam construction (i.e., pre-1973) channel slope. This excavation would begin at the existing toe of the basin dam and extend approximately 1,300 feet upstream of the Comer Drive bridge. The excavation would provide approximately 14 feet of clearance between the modified channel bottom and the underside of the Comer Drive bridge.
4. Stabilize the remaining basin sediment with added topsoil and plantings, which will match the riparian and upland vegetation habitat found both upstream and downstream of the basin. Channel features, including the area surrounding the 40-inch oak tree, would be stabilized using a combination of hard and soft-engineered systems designed to maintain the natural appearance of the restored section of the stream. Hard engineered systems include rock founded on buried concrete supports. Soft systems include mats and logs formed of material such as biodegradable coconut fiber. These soft systems would be used to line the creek channel and would support new plant growth until it is well established.

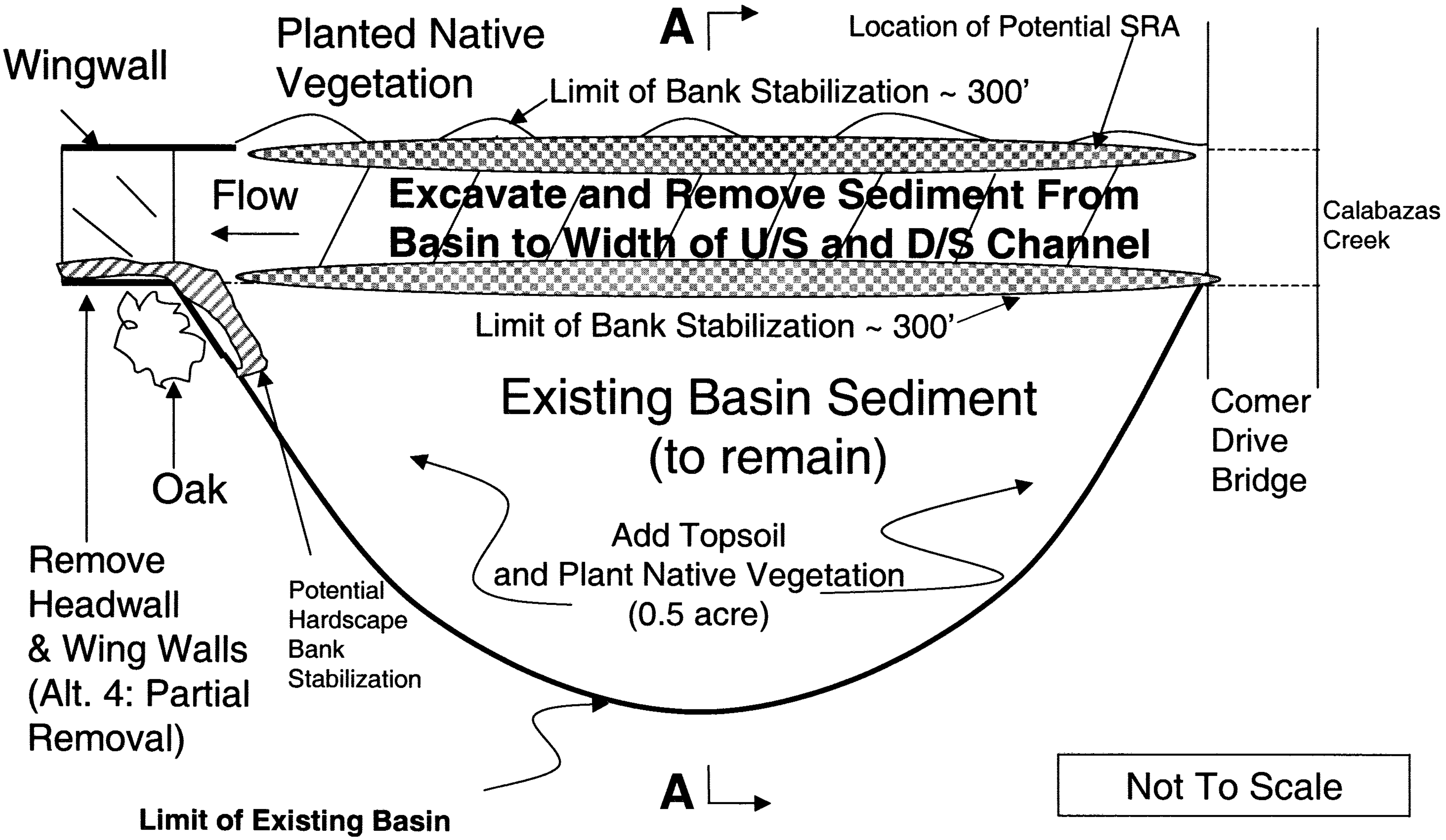
Alternative 3, shown in Figures 4.2, 4.3, and 4.5, uses the same approach as Alternative 2 for Items 1, 2, and 4. Item 3 would be modified for Alternative 3, as follows:

- Excavate the existing basin sediment with a series of at least two steps no more than 2-feet in height, which would create shallow pools and riffles (i.e., small falls) in the stream channel. These steps would be constructed between the location of the existing dam and the Comer Drive bridge, and they would be separated by approximately 100 feet. The pools and riffles formed by these steps would add to aesthetic qualities in the stream reach, and

Figure 4.1
Profile - Alternative 1: Existing Conditions

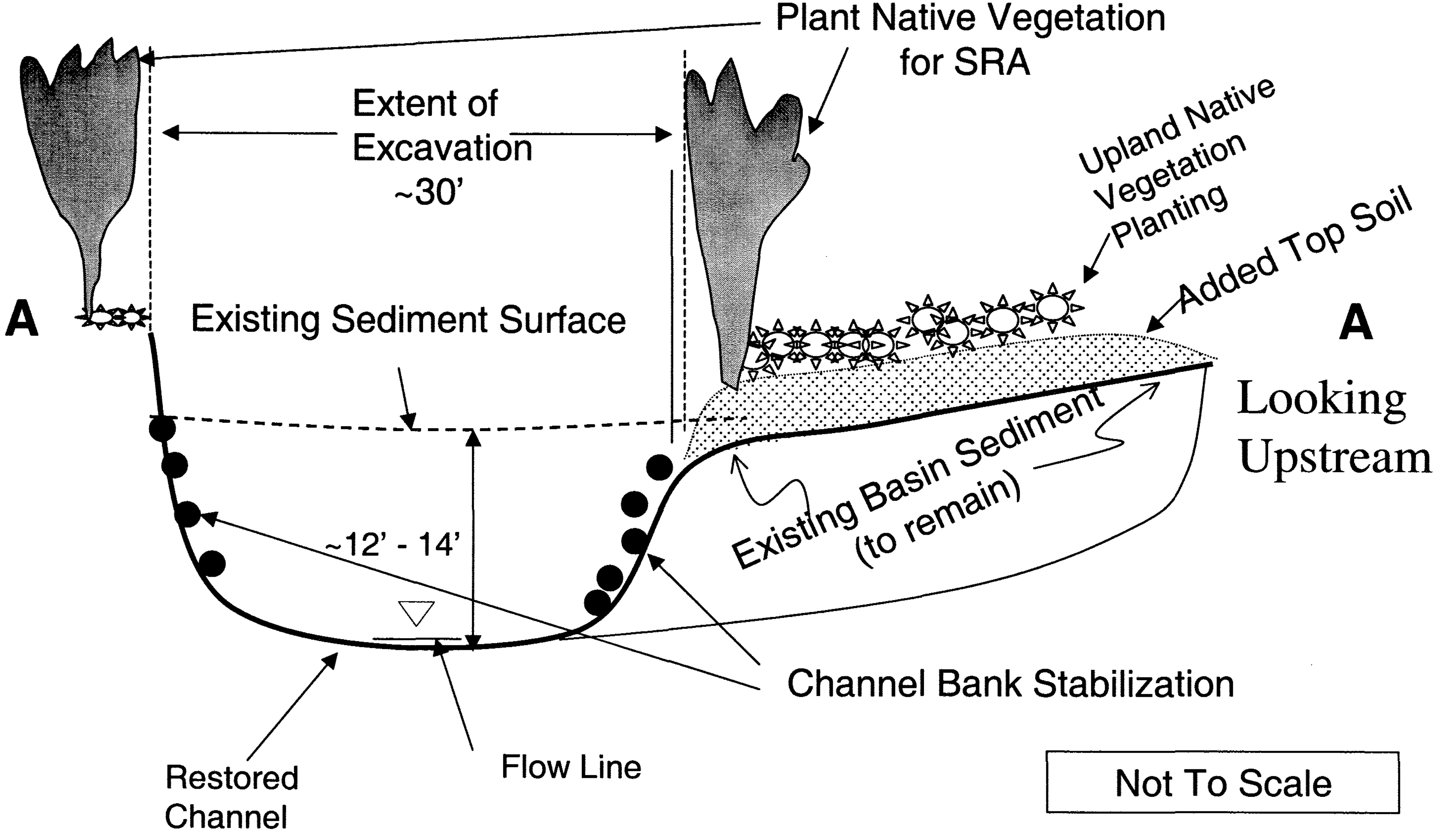


# Figure 4.2
## Plan View - Alternatives 2, 3, & 4

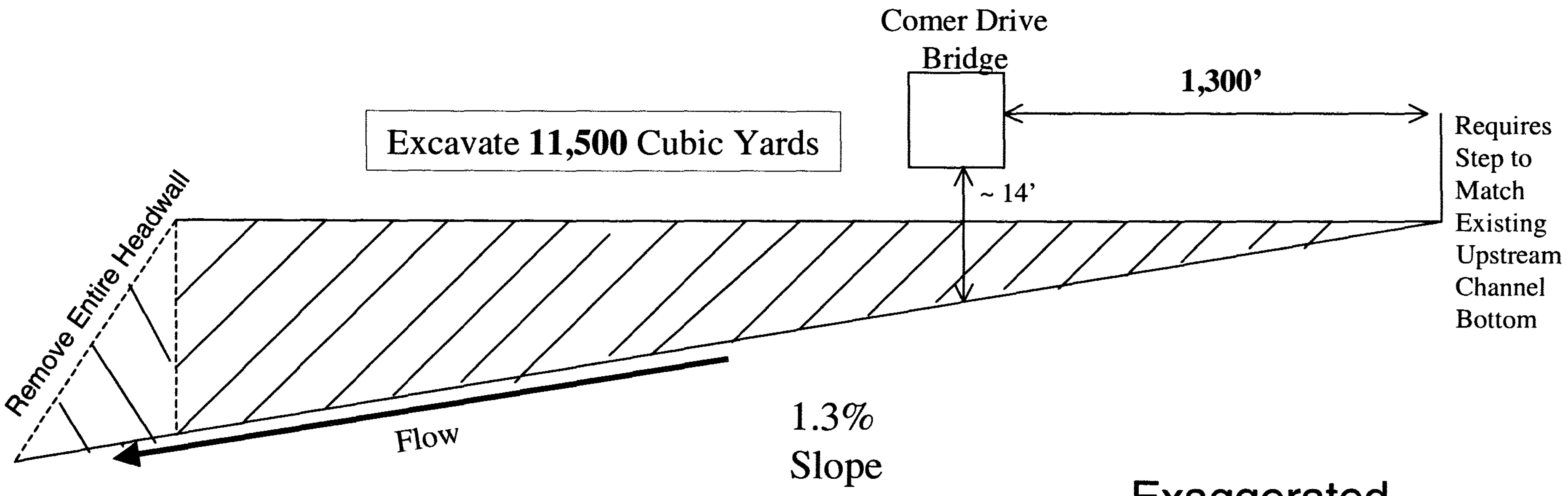

A
Planted Native Vegetation
Wingwall
Location of Potential SRA
Limit of Bank Stabilization ~ 300'
Flow
Excavate and Remove Sediment From Basin to Width of U/S and D/S Channel
Calabazas Creek
Limit of Bank Stabilization ~ 300'
Existing Basin Sediment (to remain)
Comer Drive Bridge
Oak
Add Topsoil and Plant Native Vegetation (0.5 acre)
Remove Headwall & Wing Walls (Alt. 4: Partial Removal)
Potential Hardscape Bank Stabilization
A
Limit of Existing Basin

Not To Scale

Figure 4.3
Section View - Alternatives 2 & 3


Plant Native Vegetation for SRA
A
Extent of Excavation ~30'
Existing Sediment Surface
Upland Native Vegetation Planting
Added Top Soil
A
Looking Upstream
Existing Basin Sediment (to remain)
~12' - 14'
Channel Bank Stabilization
Restored Channel
Flow Line
Not To Scale

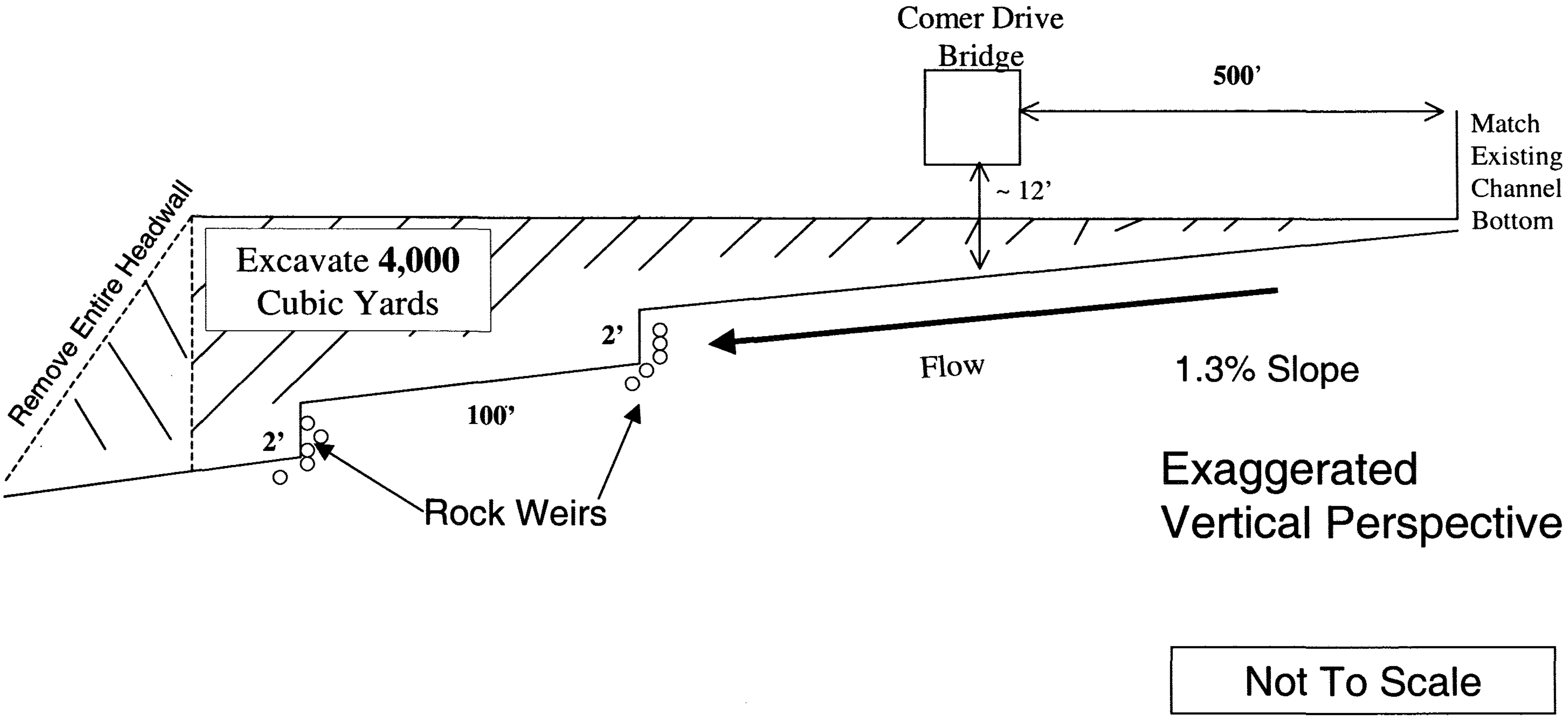
# Figure 4.4
## Profile - Alternative 2


Comer Drive Bridge
1,300'
Requires Step to Match Existing Upstream Channel Bottom
Excavate **11,500** Cubic Yards
~ 14'
Remove Entire Headwall
Flow
1.3% Slope

Exaggerated Vertical Perspective

Not To Scale

# Figure 4.5
# Profile - Alternative 3



the required extent of excavation upstream of the Comer Drive bridge would be reduced to approximately 500 feet. This configuration of channel bed would also provide approximately 12 feet of clearance between the modified channel bottom and the underside of the Comer Drive bridge.

Alternative 4 involves removing the upper 3 feet of the basin dam headwall and leaving the existing retaining walls, as shown in Figures 4.6 and 4.7. Existing basin sediment would be excavated to a depth 3 feet below the existing basin surface elevation; sediment excavation would extend approximately 50 feet upstream of the Comer Drive bridge, where a channel step would be constructed upstream of Comer Drive to match to the existing channel bed. Channel stabilization and revegetation would be conducted using the same methods and materials specified for Alternatives 2 and 3.

## 4.2 Summary of Modeling Results

In order to develop the comparison of alternatives and existing conditions, the analysis used in this feasibility study relied on computer modeling of the hydraulic performance of Calabazas Creek in the vicinity of the Comer Debris Basin. The analysis was conducted for a portion of the main channel of Calabazas Creek extending two miles upstream of the Comer Debris Basin and one mile downstream of the basin to the railroad crossing north of Wardell Road in the City of Saratoga, as shown on Figure 1.1. This portion of Calabazas Creek is referred to in this report as the "study reach." In addition, a simplified sediment transport analysis for the study reach was conducted using the results of the hydraulic analysis.

### 4.2.1 Results Summary for Hydraulic Analysis

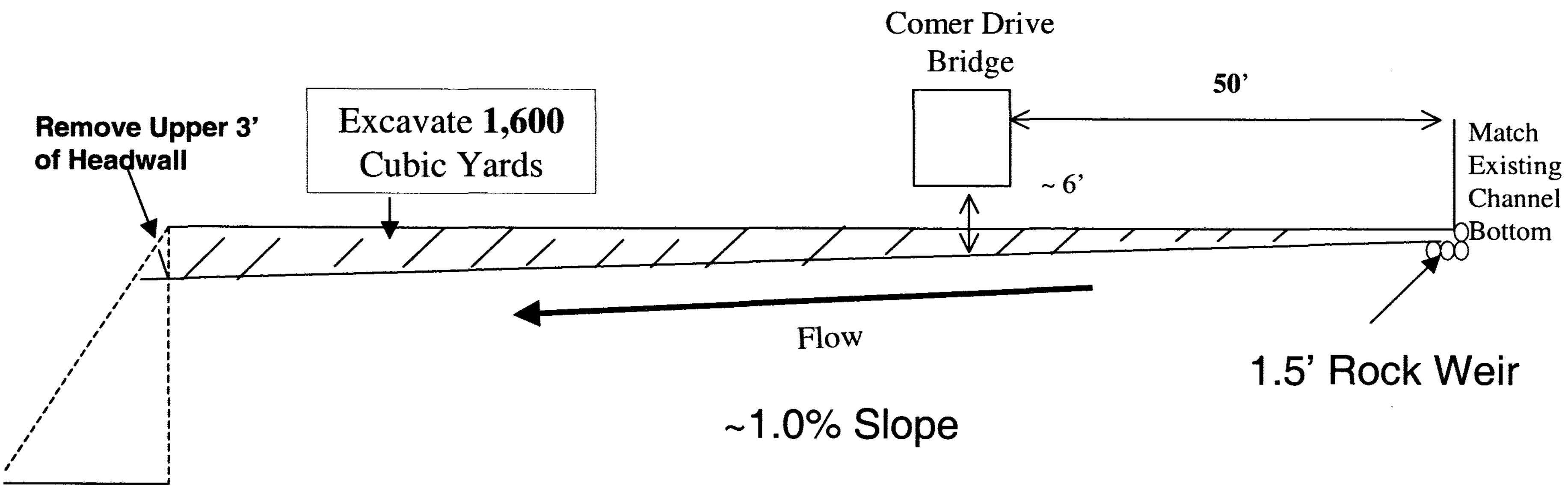
The hydraulic analysis was conducted to assess flood conveyance capacity and to generate flow data for the sediment transport analysis.

The HEC-RAS computer model was used to conduct the hydraulics analysis. The HEC-RAS model was run for existing conditions and for each alternative. Model simulations were performed for 100-year, 10-year, and 2.3-year storm events. Results from the 100-year simulation were used to evaluate flood conveyance capacity. Results from the 2.3-year simulation were used in the sediment transport analysis.

Flood conveyance capacity has been evaluated at four bridge crossings in the study reach. Table 4.1 is a summary of the results, which indicate that the Comer Drive bridge is subject to overtopping (i.e., flow passes over the bridge top deck) under existing conditions to a depth of approximately 6 inches. Alternatives 2, 3, and 4 provide for adequate flood conveyance at Comer Drive. Existing flooding conditions at the railroad crossing are not affected by these alternatives.

Figures from HEC-RAS output showing the 100-year event water surface profile at each of the bridges for existing conditions and each of the alternatives are provided in Appendix F. In addition, input data as well as summary output tables from the HEC-RAS model runs are provided in Appendix F.

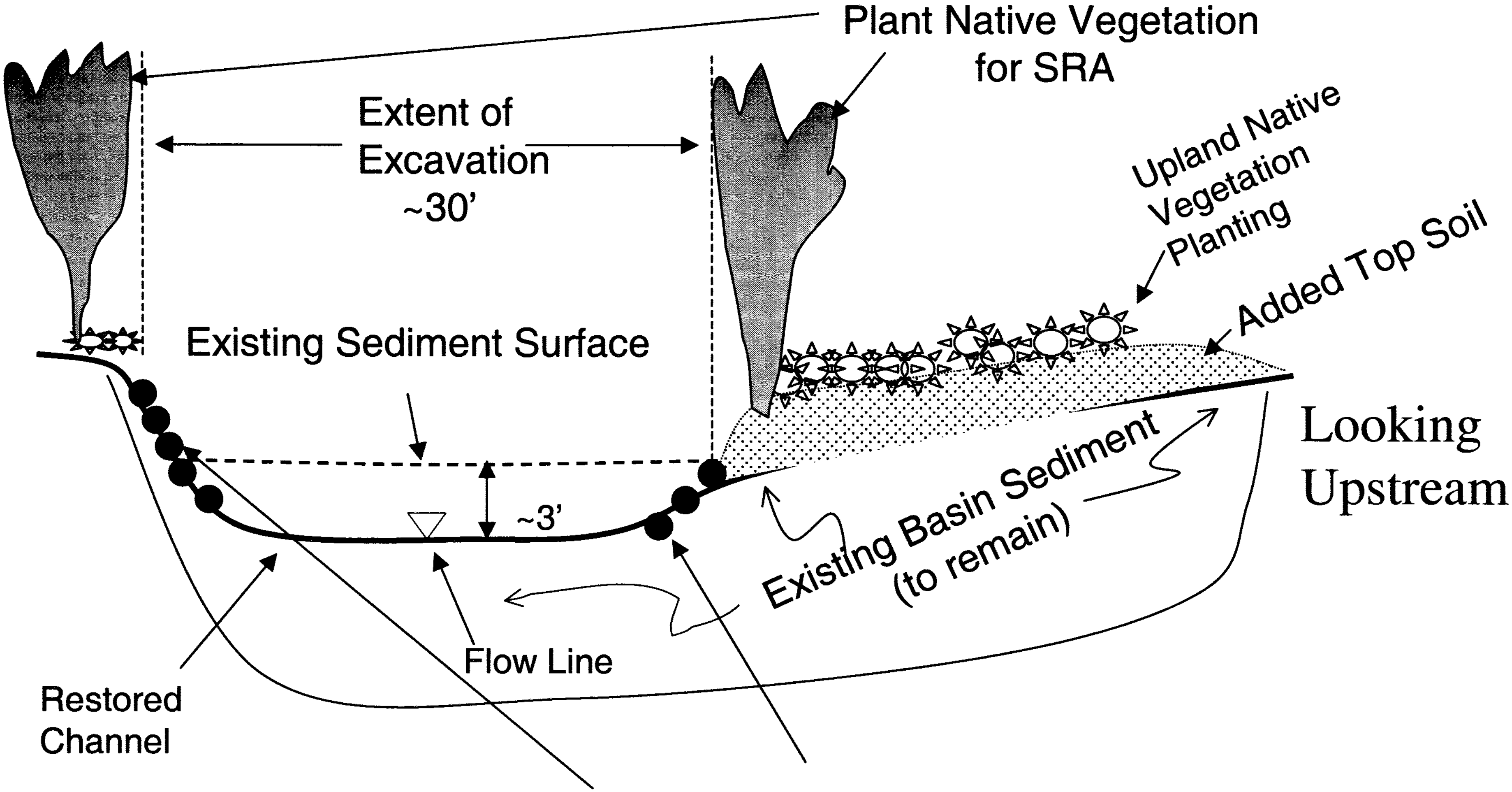
# Figure 4.6
# Profile - Alternative 4


Remove Upper 3' of Headwall
Excavate 1,600 Cubic Yards
Comer Drive Bridge
50'
~ 6'
Match Existing Channel Bottom
Flow
1.5' Rock Weir
~1.0% Slope

Exaggerated
Vertical Perspective

Not To Scale

## Figure 4.7
## Section View – Alternative 4


Plant Native Vegetation for SRA
Extent of Excavation ~30'
Upland Native Vegetation Planting
Added Top Soil
Existing Sediment Surface
~3'
Looking Upstream
Existing Basin Sediment (to remain)
Restored Channel
Flow Line
Channel Bank Stabilization

Not To Scale

# Table 4.1
## Summary of 100-Year Storm Event Results
## Comer Debris Basin Engineering Pre-Planning Study

| **Bridge** | **Bridge Deck Elevation**[1] | | **Modeled**[2] **Water Surface El. (100 year)** | | | | Flood Depth |
|---|---|---|---|---|---|---|---|
| | Lowest | Highest | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 | (ft) |
| Pierce Road | 425 | 429 | 420.52 | 420.52 | 420.52 | 420.52 | |
| Comer Drive | 371.4 | 372.5 | **372.95** | 364.29 | 364.29 | 369.33 | 0.45 |
| Wardell Road | 344 | 348 | 339.38 | 339.38 | 339.38 | 339.38 | |
| Railroad | 317.6 | 319.5 | **322.02** | **322.02** | **322.02** | **322.02** | 2.52 |

Notes
1) Elevations are reported in feet and are based on NGVD 1927.
2) Modeled water surface elevations taken from HEC-RAS model run for study reach with Q = 1,180 cfs.
3) **Boldface** indicates modeled water surface elevation overtops the highest bridge deck elevation.

### 4.2.2 Results Summary for Sediment Transport Analysis

The sediment transport analysis was performed for existing conditions and for each of the two alternatives using the results of the hydraulics evaluation for the 2.3-year event. The analysis involved estimating an upstream sediment supply and passing that supply through the study reach to estimate where sediment deposition or erosion might occur.

The analysis involved comparing the sediment supply to the sediment capacity of the stream at specific locations in the stream channel. Those locations correspond to the surveyed cross section stations used in the hydraulics analysis; the HEC-RAS model generated flow characteristics (e.g. water depth, flow velocity) for the stream at each cross section station. Using the hydraulic information, sediment transport capacity was computed at the channel station as a function of the slope, flow velocity, and depth of flow. Sample calculations, summary data tables, and results of a sensitivity analysis for the sediment transport analysis are presented in Appendix G.

The sediment transport analysis was conducted for each cross section station in the study reach, and the results are based on the following:

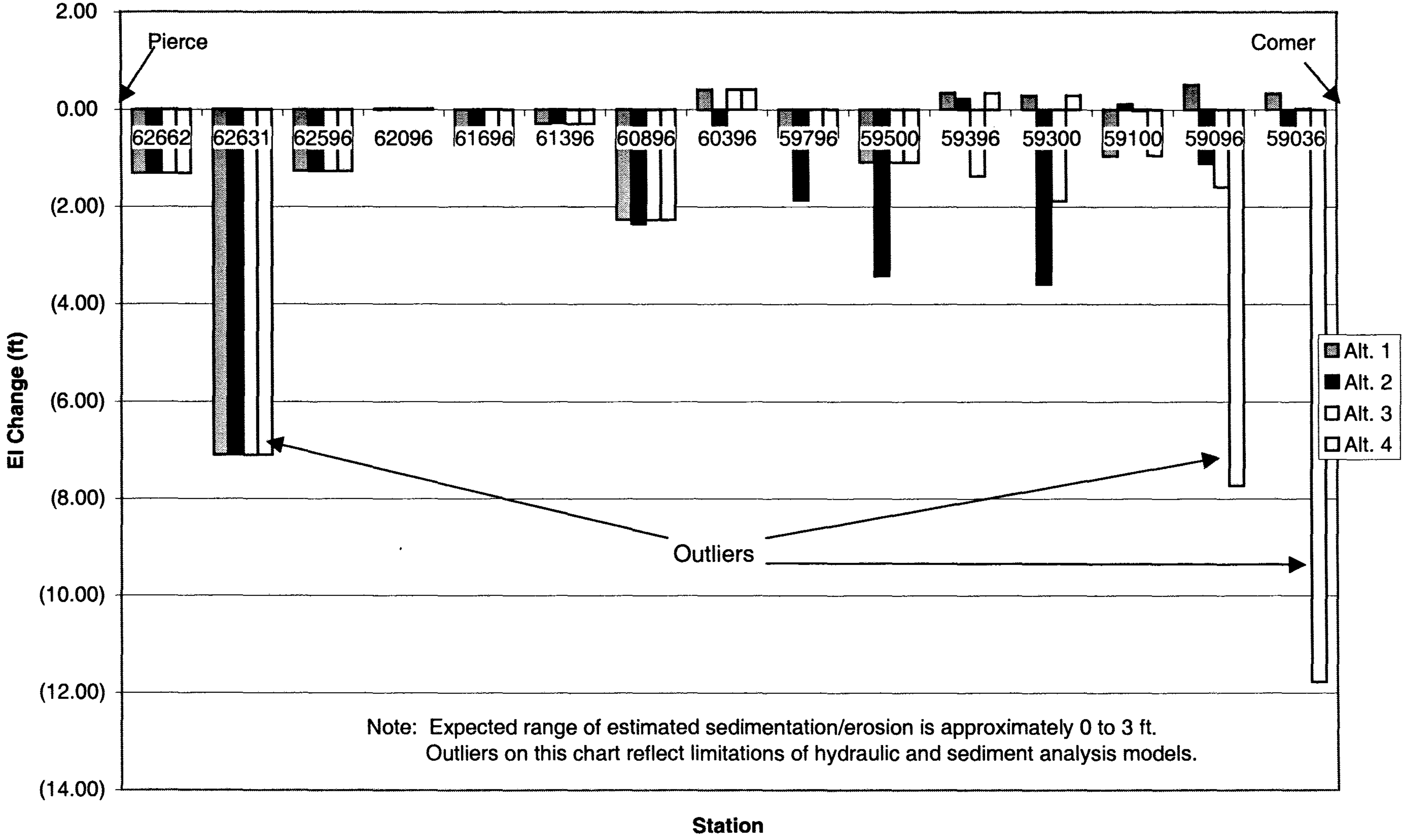
- If the sediment supply is greater than the capacity, sediment deposition, referred to as aggradation, will occur.
- If the sediment supply is less than the capacity, erosion of stream channel will occur. (This method does not address the magnitude of stream meander and bank erosion.)

Figures 4.8, 4.9, and 4.10 are graphical summaries of the results of this analysis. The extent of the study reach shown in the figures is the Pierce Road bridge to the railroad crossing. Results are plotted for each cross section station. Negative values indicate the estimated magnitude of possible erosion at that station; positive values indicate the estimated amount of possible sediment deposition.

The results have been used to compare the impacts on sediment transport between the alternatives and existing conditions. Results can be summarized as follows:

- Sediment transport characteristics downstream of the location of the existing Comer Debris Basin dam remain the same if no action is taken (i.e., existing conditions) or if one of the alternatives is implemented. Downstream results are shown in Figures 4.9 and 4.10.
- Each of the alternatives to existing conditions results in the potential for additional channel bed erosion upstream of the current dam location. However, because existing conditions consist of an artificially created deposition area upstream of the dam, additional channel bed erosion appears likely if the basin area were restored to a natural channel configuration. If a channel restoration project were to be selected, a stable channel configuration, which is a function of both the channel slope and width, would be identified for the restored channel section during a future design phase.

**Figure 4.8**
**Estimated Sedimentation/Erosion - Pierce to Comer**
**(Sediment Supply 9,000 tons over 35 days)**



Note: Expected range of estimated sedimentation/erosion is approximately 0 to 3 ft.
Outliers on this chart reflect limitations of hydraulic and sediment analysis models.

## Figure 4.9
## Estimated Sedimentation/Erosion - Comer to Wardell
## (Sediment Supply 9,000 tons over 35 days)

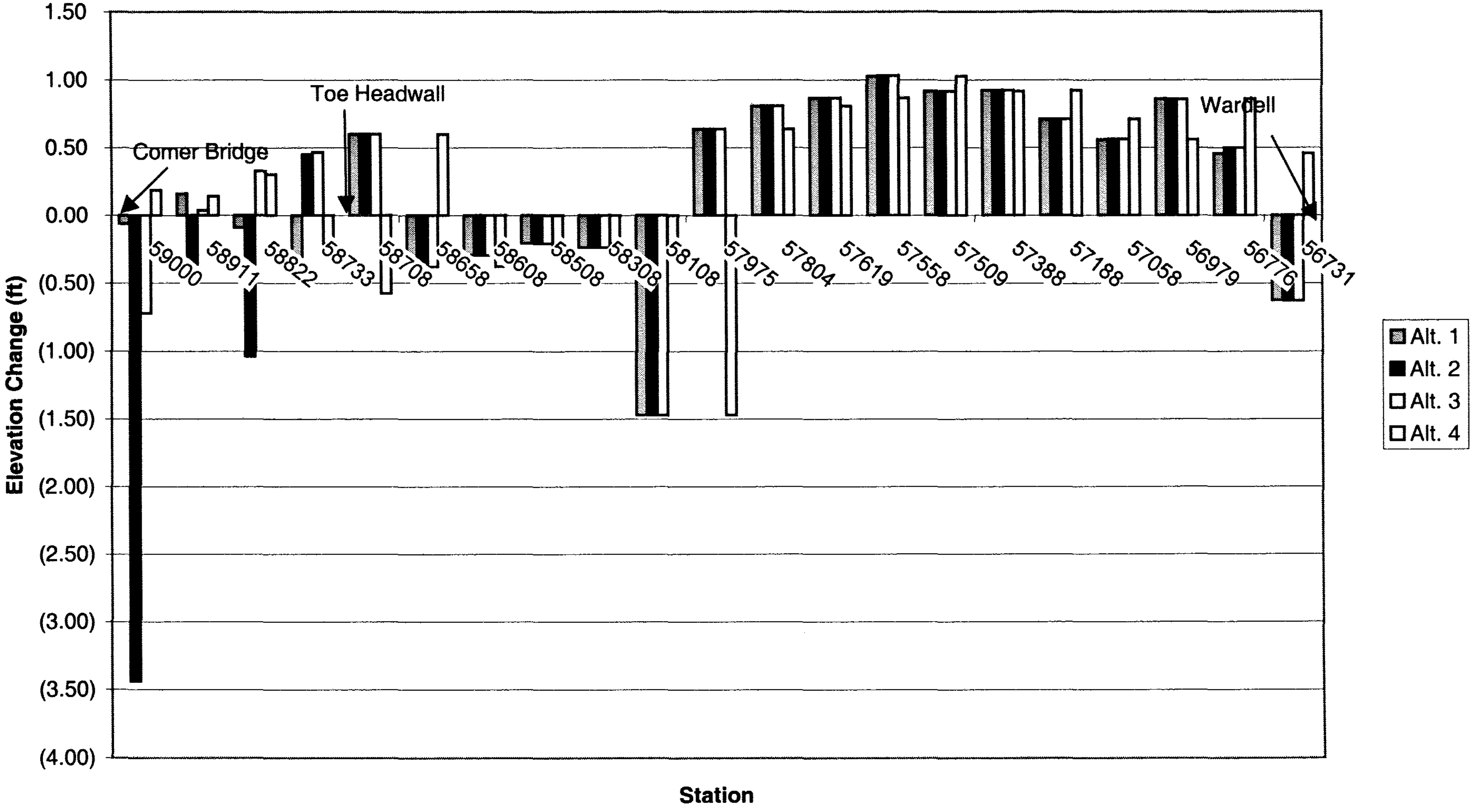
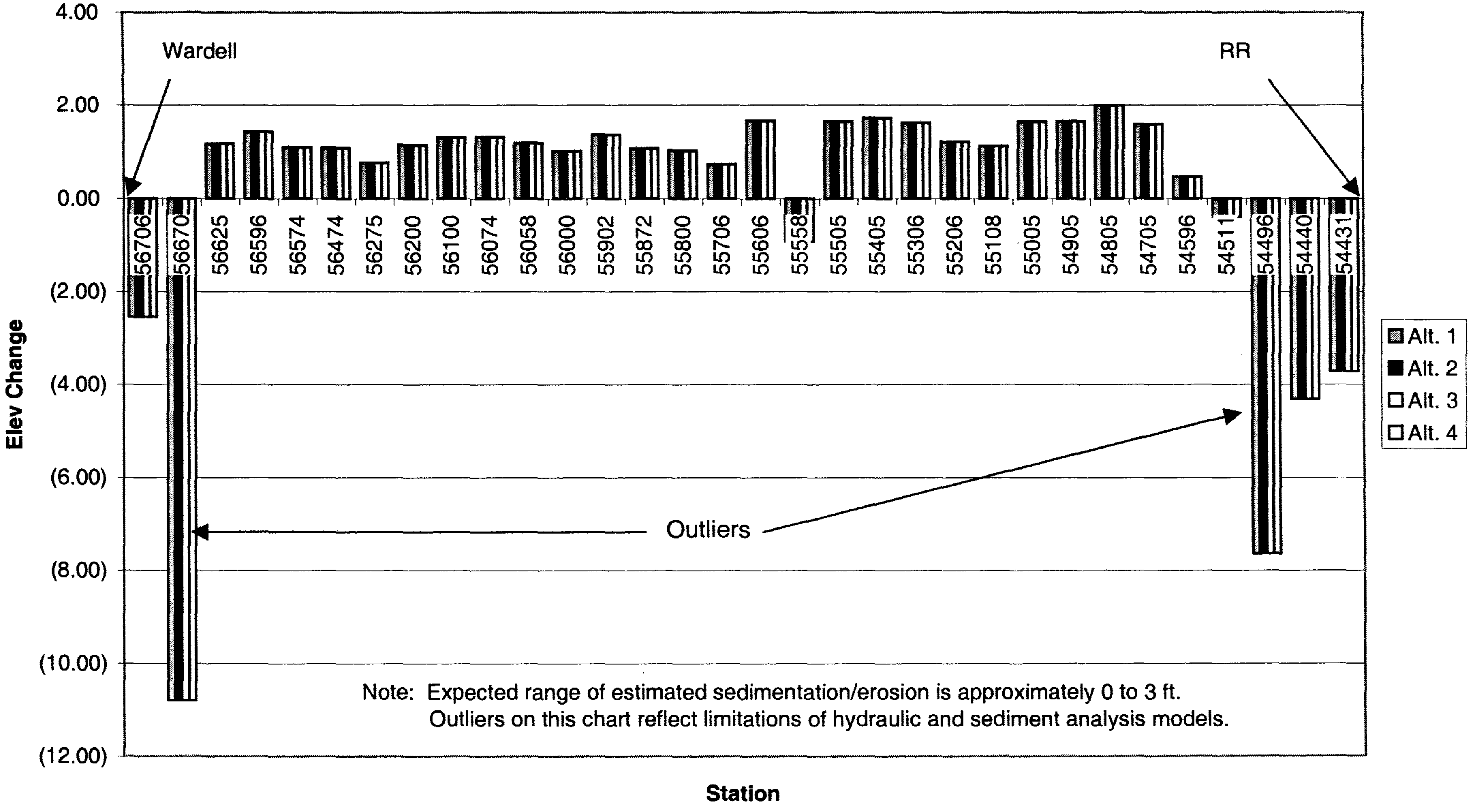


**Figure 4.10**
**Estimated Sedimentation/Erosion - Wardell to RR**
**(Sediment Supply 9,000 tons over 35 days)**



Note: Expected range of estimated sedimentation/erosion is approximately 0 to 3 ft.
Outliers on this chart reflect limitations of hydraulic and sediment analysis models.

## 4.3 Modeling Assumptions

### 4.3.1 Hydraulic Analysis Assumptions

The hydraulic analysis was conducted using the following assumptions.

1. The District provided input files to the U.S. Army Corps Hydrologic Engineering Center (HEC) HEC-2 hydraulics analysis computer model for the study reach portion of Calabazas Creek. These data files are dated 1978 and have been considered valid representations of creek channel and bridge crossing geometry.
2. The HEC-RAS model is an updated version of HEC-2, and it is commonly used for estimating hydraulic performance of natural streams. It was assumed there would be no loss of modeling accuracy in using this model with the original HEC-2 input files.
3. The input files cited in Item 1 were imported and modified with stream channel survey data from 1987 and 2001 to generate a single input file that has been assumed to be a reasonable representation of existing conditions in the study reach.
4. The District provided a 100-year storm event flow of 1,180 cfs for assessing flood conveyance capacity. This value was used without modification over the entire study reach; the original District HEC-2 input files changed the flow rate at various locations over the study reach. It has been assumed that use of a continuous flow rate will provide a reasonable estimate of flood conveyance capacity.
5. It has been assumed that the pre-dam construction (i.e., pre-1973) channel slope through the basin area was at an equilibrium condition. This means there was no net sedimentation or erosion that would change the elevation of the channel bed in the study reach over a long period. The hydraulics modeling Alternatives 2 and 3 was developed to match the pre-dam construction channel slope.
6. The hydraulics modeling has been assumed to provide a reasonable approximation of actual flow regime in the study reach. Some corroboration of the hydraulics modeling with field data was obtained from dated flow height markings on the Wardell Road bridge and gage data for the specified date of 11 February 1992. The water surface elevation estimated for that location in the study reach appears to correspond within 0.5 feet with the bridge markings. A summary output table for this verification analysis from HEC-RAS has been included in Appendix F.

### 4.3.2 Sediment Transport Analysis Assumptions

The sediment transport analysis was conducted using a mass balance approach to assess the potential for aggradation (i.e., the deposition of sediment) or erosion at the surveyed cross sections used for the hydraulic analysis. The analysis was conducted for existing conditions and for each of the three alternatives. The following assumptions were used for this analysis:

1. The sediment transport analysis is a comparative tool for assessing impacts of alternatives with respect to existing conditions. Given limited field verification of the results, the analysis

has been assumed to be valid strictly for comparison between the results for the alternatives and the results for existing conditions.

2. The approach is a mass balance analytical method that is based on a methodology documented by the Federal Highway Administration (HEC-20) [Ref. 2]. The regression equation approach presented in HEC-20 has been developed for scenarios more common in the Eastern U.S. HEC-20 assumes a wide stream with moderate channel slopes, moderate flow velocities, and fine particulate sediment. These conditions are not met in all parts of the study reach. However, analytical methods for estimating deposition or erosion that are applicable to steeper Western U.S. scenarios are few in number, have not yet been adopted for general use, and have not been identified for use in this study.

3. No sediment samples were collected for sieve analysis for this study and no particle distribution curve was generated. The particle size distribution curve provided in HEC-20 Figure E.1 [Ref. 2] was assumed to be valid for this study based on field observations, and it was used in the sediment transport analysis.

4. It was assumed that the upstream sediment supply entering the study reach was generated during three or four major storm events during the water year, which extends from November to March. The analysis used a duration of 35 days for the typical period of active sediment supply generation.

5. The sediment supply load was estimated based on District maintenance records and the sediment study conducted between 1973 and 1975 by the USGS [Ref. 1]. The USGS estimated that sand and gravel excavated from the Comer Debris Basin consisted of approximately 40 percent of the total stream sediment load. The estimated total sediment supply volume used in the analysis has been assumed to be 60 percent larger than the volume obtained from the District maintenance records.

6. The sediment analysis was conducted for the 2.3-year storm event using a flow rate of 220 cfs supplied by the District. Sediment transport analysis typically uses the 2.3 year event because the majority of sediment transport occurs during these more frequent storm events.

# Section 5: ALTERNATIVES EVALUATION AND FINDINGS

The alternatives evaluation involved the comparison of the estimated impacts of the alternatives to existing conditions. The comparison was used to assess whether the alternatives offer benefits over existing conditions.

## 5.1 Identification of Evaluation Criteria

Based on the constraints identified in Section 3, the District has recommended the following evaluation criteria.

**Financial**

- Project Cost

**Physical**

- Potential for increasing or decreasing upstream and/or downstream flooding
- Potential impacts or improvements to upstream and/or downstream sedimentation/erosion
- Potential impacts or improvements to creek maintenance

**Biological**

- Potential impacts or improvements to existing aquatic habitat
- Potential impacts or improvements to terrestrial habitat

**Public Interest**

- Potential impacts or improvements to aesthetics
- Potential impacts or improvements to stream channel access
- Potential opportunities for community involvement

## 5.2 Summary of Alternatives Evaluation

### 5.2.1 Assessment of Possible Impacts on Channel Flood Conveyance Capacity

The hydraulic modeling results indicate that the 100-year flood would result in an overtopping of the Comer Drive bridge by approximately 6 inches. Alternatives 2 and 3 provide a significant improvement over existing conditions by alleviating possible flooding of the Comer Drive bridge during the 100-year event. Alternatives 2 and 3 result in restored clearance between the lowest chord on the bridge and the restored channel bottom of approximately 14 feet and 12 feet, respectively. Alternative 4 provides sufficient capacity at the Comer Drive bridge to convey the 100-year event; clearance between the lowest bridge chord and the restored channel bottom would be approximately 6 feet. This improvement in flood conveyance capacity would reduce the potential flood risk in the immediate vicinity of the basin, and it would help to satisfy the District's mandate to maintain flood conveyance capacity.

Hydraulic modeling results suggest that there are no other significant impacts to flood conveyance capacity due to the implementation of the three alternatives; existing flooding conditions at the railroad crossing downstream of the Comer Debris Basin are not affected by implementation of any of the alternatives.

### 5.2.2 Assessment of Possible Impacts on Sedimentation/Erosion

Existing conditions appear to produce conditions with less potential for erosion than the three alternatives in the portion of the study reach encompassing the Comer Debris Basin. As indicated in Section 4.2.2, existing conditions consist of an artificial deposition area behind the basin dam, and channel restoration through the basin area that does not result in a stable channel section would result in channel bed erosion.

There is no indication from the study results that the sediment transport characteristics would be improved by implementation of the alternatives. Negative impacts (i.e., erosional flows) are expected to be limited to the restored channel through the debris basin and upstream of the Comer Drive bridge. Impacts to the sediment transport characteristics in the study reach caused by implementation of Alternatives 2, 3, and 4 are estimated to be limited to the Comer Debris Basin and up to 1,300 feet upstream of Comer Drive.

The District's direction for the sediment transport analysis specified that the alternatives be evaluated by identifying a stable channel condition through the Comer Debris Basin (i.e, one that was not subject to erosion or aggradation). Alternatives 2 and 3 were developed using the slope identified from pre-dam construction stream profiles, which has been assumed to be an "equilibrium channel slope." Alternative 4 was developed to minimize the required volume of excavation of existing basin sediment and is not based on an equilibrium channel slope.

The results for Alternative 2 indicate a significant potential for erosion in the vicinity of the Comer Debris Basin. It was found that the restored channel slope (set at the assumed equilibrium slope value) for Alternative 2 did not converge with the existing upstream channel bottom, and remained no closer than 2 feet below the existing upstream channel slope elevation. This configuration was modeled to a distance of approximately 1,600 feet upstream of the Comer Drive bridge. The extent of the upstream impacts from this alternative reflect choices made in the analysis. The slope of Alternative 2 would need to be made steeper, or a channel step would be required to produce a feasible scenario for Alterative 2. These slope changes would make the Alternative 2 configuration similar to Alternative 3.

It is anticipated that a possible future design phase would define a stable channel section for stream restoration in this portion of the creek. For a given flow rate and sediment supply, a stable channel geometry is a function of the channel slope and width. Definition of a stable channel section requires an iterative process to identify the combination of channel slope and width that is expected to be in equilibrium [Ref. 3]. The sediment transport analysis for this study assumed a channel width equal to the existing upstream and downstream channel width. The results suggest the assumed configuration is not in equilibrium.

If an alternative is selected to modify or remove the basin, it is left to a future design effort to identify the channel slope and width combination that will produce a stable channel section. It is expected that an equilibrium channel geometry can be generated for the Comer Debris Basin through proper selection of channel slope and width.

### 5.2.3 Assessment of Possible Impacts on Environment: Aquatic Biology and Wildlife

The improvements to the stream channel in the vicinity of the Comer Debris Basin through the implementation of Alternatives 2, 3, and 4 would provide improvements in available aquatic and terrestrial habitat in the area of the existing debris basin. Following are additional elements of this assessment:

- Implementation of Alternatives 2, 3, and 4 would result in the creation of 300 to 400 feet of SRA habitat along the restored stream channel in the location of the former debris basin.

- Alternatives 2, 3, and 4 would provide for additional terrestrial habitat in the location of the former debris basin through the addition of approximately ½ acre of native upland vegetation.

- Alternative 3 would offer improved opportunities for aquatic species during the wet season through the creation of two 1,600 $ft^2$ shallow pools in the stream channel. The pools created by Alternative 3 would be ephemeral (i.e, dry in summer months to minimize nuisance insect populations).

- Construction required for Alternatives 2, 3, and 4 would cause short-term disruption of existing habitat. Disturbance would extend upstream of the Comer Drive bridge approximately 1,300 feet for Alternative 2, approximately 500 feet for Alternative 3, and approximately 50 feet for Alternative 4. In addition, wetlands delineation must be performed as part of a possible future pre-design effort to identify wetlands areas, if any, that must be mitigated if they are subject to damage during construction.

- No red-legged frog or western pond turtle habitats have been identified in the vicinity of the Comer Debris Basin. Implementation of any one of the alternatives does not appear to produce significant impacts to sensitive species habitat.

### 5.2.4 Assessment of Constructability of Alternatives

All of the alternatives to existing conditions involve standard construction methods and are considered to be feasible for construction. The constructability assessment was conducted in consultation with Power Engineering, Alameda, a construction contractor that was added to the consulting team to provide "value engineering" recommendations. The alternatives involve the following:

- Demolition of the concrete structure. For Alternative 2 and 3, it is expected that the retaining walls on either side of the dam, which are supported by the dam wall, would also be demolished. Alternative 4 involves the demolition of the upper 3 feet of the basin dam. The remaining retaining walls would require stabilization through the addition of concrete at their bases to protect against damage from high stream flows.

- Excavation of basin sediment. The excavation work would establish a channel section with a slope and width identified for stable channel geometry (i.e., an equilibrium channel section).

- Stabilization of remaining slopes. For Alternatives 2 and 3, stabilization of exposed slopes would be required, especially in the vicinity of 40-inch oak tree and on the stream channel bank opposite the 40-inch oak. Alternative 4 would not involve removal of the retaining walls protecting the 40-inch oak. Alternatives 2, 3, and 4 would require stabilization of the sediment remaining in the basin following excavation of the restored channel.

Additional construction work will be required for the following:

- Protection of the 40-inch oak following removal of the concrete structure will be required. This work is expected to involve additional rock material with concrete supports. (This applies only to Alternatives 2 and 3.)

- Alternative 3 will require additional concrete and rock material to construct the channel steps.

- Alternatives 2, 3, and 4 would require improvements to stabilize the sediment remaining in the basin to establish new growth to promote the formation of SRA and upland terrestrial habitat. The work will include adding topsoil and plantings. Channel stabilization would be achieved using soft engineering methods, such as those referenced in Section 4.1.

Differences in constructability between the alternatives are expected to involve the following:

- Construction of the channel steps for Alternative 3 would require additional resources than Alternatives 2 or 4.

- The channel slope designed for Alternative 2 results in impacts farther upstream in the channel than for Alternatives 3 and 4.

- Alternative 2 requires the excavation and management of a larger volume of sediment than Alternatives 3 or 4.

- Alternative 4 requires the excavation and management of a smaller volume of sediment than for Alternatives 2 and 3. However, Alternative 4 requires additional resources to stabilize the retaining walls at the ends of the basin dam after removal of the upper 3 feet of the dam structure.

### 5.2.5 Cost Estimates

Preliminary estimates of the probable costs for each alternative are as follows:

| Alternative | Design & Construction Cost | Annual O & M Costs |
|---|---|---|
| 1 | No additional cost to District | No additional cost to District |
| 2 | $1,250,000 | $14,500 |
| 3 | $890,000 | $20,000 |
| 4 | $590,000 | $14,500 |

These costs are based on the conceptual level of this feasibility study and should be considered order-of-magnitude estimates, rather than definitive cost estimates. Detailed summaries of the estimated costs are provided in Appendix I.

Estimated design and construction costs include the following:

- Planning: Costs for preparing CEQA documentation.
- Permitting: Managing the project through the permitting phase as described in Section 3.4.3.
- Engineering Costs: Engineering costs have estimated to account for the following anticipated work elements:
    - Additional analysis for hydraulics and sediment transport, including additional data collection
    - Engineering report
    - Design documents
    - Participation in public meetings
    - Construction management or oversight
- Concrete Demolition: The entire headwall and attached wingwalls will be removed for Alternatives 2 and 3. Alternative 4 involves partial demolition of the basin dam. Costs include off-haul and disposal.
- Sediment Excavation: The alternatives have been developed with the expectation that the sediment that is excavated will be hauled offsite rather than being regraded over the stream channel bed up to 1,000 feet both upstream and downstream of the basin. There is approximately 7,500 cubic yards less excavation required for Alternative 3 than for Alternative 2. Alternative 4 results in an estimated excavation volume of 1,600 cubic yards, which is 2,400 cubic yards less than for Alternative 3.

- Stream Restoration: Costs for this work differ between Alternatives 2 and 3 due to the requirement for rock steps in the channel for Alternative 3. Costs for Alternative 4 are less than for Alternatives 2 and 3 because the required length of the restored channel section is significantly less would be required for Alternatives 2 and 3. Costs include stream restoration and revegetation.

No operations and maintenance (O&M) costs are anticipated for Alternative 1. Estimated annual O&M costs for Alternatives 2, 3, and 4 include the following:

- Maintenance visits by District staff at least every 6 months to inspect conditions at the former debris basin and to repair significantly damaged parts of the restored stream channel. Two additional annual visits were anticipated for Alternative 3 to account for a possible need to clear large pieces of debris that may have accumulated in the small ponds.

- Monthly monitoring visits by a District biologist to observe habitat conditions in the restored stream channel and in the planted, native upland vegetation area in the former debris basin.

- The regular visits by maintenance staff and District biologists would also be used during the first three years following completion of construction to monitor progress of the establishment of the restored vegetation. In addition, visits by District biologists are expected to satisfy any applicable permit monitoring requirements.

A comparative summary of the alternatives, including information on benefits and costs, is provided in Table 5.1.

## 5.3 Findings

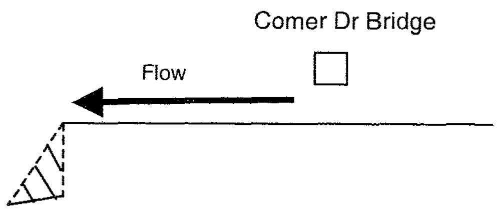
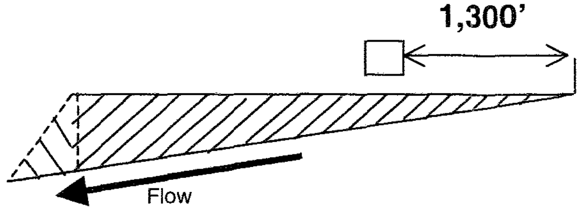
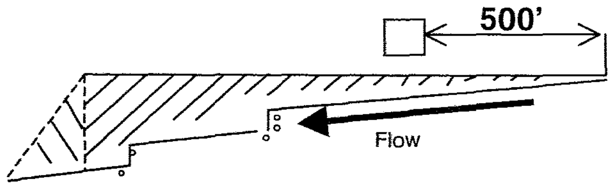
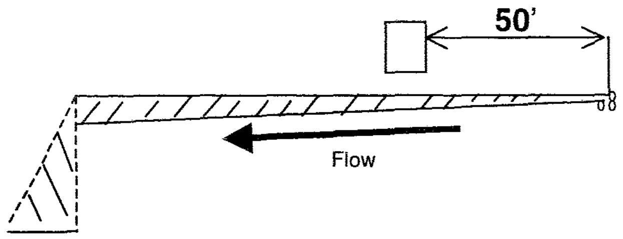
The alternatives to existing conditions identified for this preliminary feasibility study would provide improvements over existing conditions in terms of flood conveyance, habitat creation, and aesthetics.

- Alternatives 2 and 3 offer a significant improvement over existing conditions in flood conveyance capacity at the Comer Drive bridge. The clearance between the lowest chord of the bridge and the restored channel bottom would be approximately 14 feet for Alternative 2 and approximately 12 feet for Alternative 3. Alternative 4 has been developed to offer adequate conveyance capacity at the bridge, providing clearance of 6 feet.

- Alternatives 2, 3, and 4, as modeled for this feasibility study, do not adversely impact or significantly alter existing sediment transport conditions in the study reach portion of Calabazas Creek.

- Implementation of Alternatives 2, 3, or 4 would each result in the creation of 300 to 400 feet of SRA habitat in the restored stream channel. In addition, approximately ½ acre of native upland vegetation and terrestrial habitat would be created by each of these alternatives in the former debris basin location.

# Table 5.1
## Comparative Summary of Alternatives
## Comer Debris Basin Engineering Feasibility Study

| Criteria | Alternative 1: Existing Conditions | Alternative 2: Remove Headwall, Grade Uniform, Equilibrium Slope | Alternative 3: Remove Headwall, Construct Steps in Channel for Pools | Alternative 4: Partial Headwall Removal, Limited Excavation |
|---|---|---|---|---|
|  |  |  |  |  |
| Preliminary Project Cost | No additional cost to District. | $1,250,000 | $890,000 | $590,000 |
| Construction |  | $1,000,000 | $640,000 | $340,000 |
| Planning/Permitting |  | $100,000 | $100,000 | $100,000 |
| Pre-Design/Design/Oversight |  | $150,000 | $150,000 | $150,000 |
| Annual O & M |  | $14,500 | $20,000 | $14,500 |
| Physical |  |  |  |  |
| General Description | Current conditions. 12-foot concrete dam with retaining walls. Basin filled with sediment 300 ft x 150 ft. Approx 4-foot clearance at Comer. | Remove concrete structure, excavate existing sediment to width of upstream channel, establish uniform slope, stabilize remaining sediment. | Remove concrete structure, excavate existing sediment to width of upstream channel, establish steps in slope, stabilize remaining sediment. | Remove upper 3' of concrete structure, excavate existing sediment to depth of 3' to width of upstream channel, stabilize remaining sediment. |
| Flooding | Overtopping at Comer Drive bridge is potential public safety risk. | Removes flood risk at Comer Drive bridge. | Removes flood risk at Comer Drive bridge. | Removes flood risk at Comer Drive bridge. |
| Sedimentation/Erosion | Dam construction in 1973/74 trapped sediment and resulted in downcutting of downstream channel bed. Currently, downstream section appears to be accumulating sediment. | No change in sediment flow caused by this alternative. | No change in sediment flow caused by this alternative. | No change in sediment flow caused by this alternative. |
| Maintenance | No maintenance since 1992. | Restored channel and revegetated areas require periodic maintenance inspection. | Restored channel and revegetated areas require periodic maintenance inspection. | Restored channel and revegetated areas require periodic maintenance inspection. |
| Environmental/Biological |  |  |  |  |
| Aquatic | Pools at base of dam with chorus frog tadpoles. No red-legged frog or western pond turtle habitat. | Creates 300 to 400 feet of SRA habitat. Pools no longer formed, reducing existing aquatic habitat. New SRA may increase habitat opportunities for western pond turtle or other sensitive species. | Creates 300 to 400 feet of SRA habitat. Pools formed during wet months; expected to remain some time into dry months. Habitat opportunities better for aquatic species than Alternatives 2 and 4. | Creates 300 to 400 feet of SRA habitat. Pools no longer formed, reducing existing aquatic habitat. New SRA may increase habitat opportunities for western pond turtle or other sensitive species. |
| Terrestrial | Evidence of deer, Cooper's Hawk. Debris basin area is open, with little cover for habitat. | Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added. | Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added. | Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added. |
| Public Interest |  |  |  |  |
| Aesthetics | Presence of debris basin dam limits aesthetics of stream. | Formation of SRA in restored channel will integrate existing SRA habitat upstream and downstream of the debris basin. | In addition to increasing SRA through the former debris basin, addition of pools and small falls offer improved aesthetics over Alternatives 1, 2, and 4. | Remaining 9 vertical feet of dam headwall reduce aesthetic appeal of this Alternative. |
| Access | Limited. Basin dam forms obstruction to easy use of this part of the creek. | Same as existing. | Same as existing. | Same as existing. |
| Community Involvement | None known at this time. | Opportunity for community to participate in and observe stream restoration effort. | Opportunity for community to participate in and observe stream restoration effort. | Opportunity for community to participate in and observe stream restoration effort. |

- Implementation of Alternative 3 would improve opportunities for aquatic species through the formation of ephemeral pools. At least two ephemeral pools, each with an estimated area of 1,600 $ft^2$, would be created in the restored stream channel.

- Implementation of Alternatives 2 and 3 would improve aesthetics following complete removal of the headwall structure and the creation of SRA habitat. Alternative 3 would provide for greater aesthetic improvements through the formation of pools and riffles (small falls).

- No red-legged frog or western pond turtle habitats have been identified in the vicinity of the Comer Debris Basin. Implementation of any one of the alternatives does not appear to produce significant impacts to sensitive species habitat.

- Wetlands delineation must be performed as part of a possible future pre-design effort to identify wetlands areas, if any, that must be mitigated if they are subject to damage during construction.

If the District were to take no action, existing conditions at the Comer Debris Basin would not change the potential for flooding at the Comer Drive bridge during the 100-year event. However, the sediment transport regime would remain at what is apparently already an equilibrium condition in the vicinity of the debris basin.

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4. Bureau of Reclamation, 1987, Design of Small Dams. U.S. Department of the Interior. Appendix A.

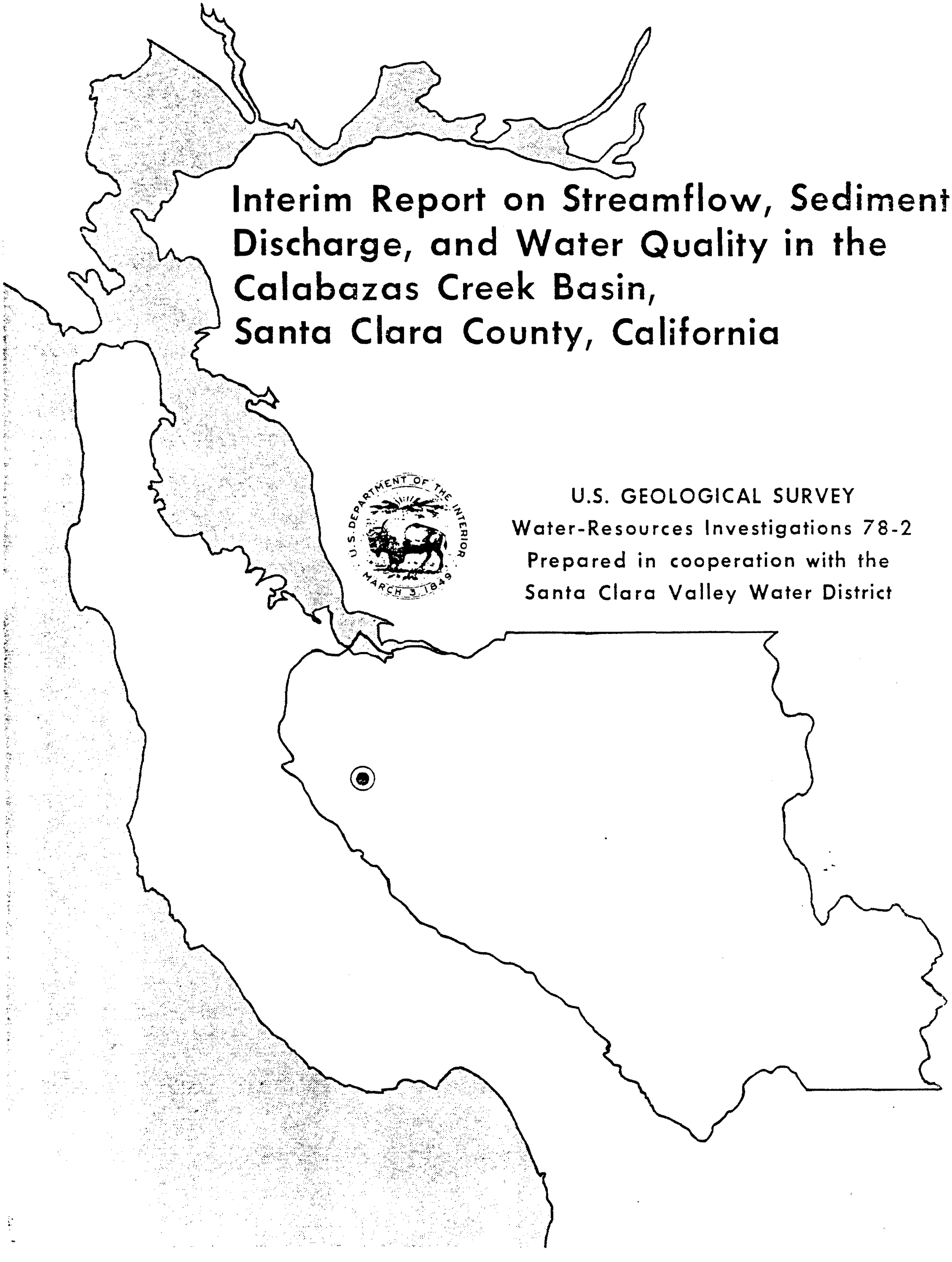
# Appendix A

## BACKGROUND INFORMATION
## PROVIDED BY
## SANTA CLARA VALLEY WATER DISTRICT

Item 6

TALLEY

# Interim Report on Streamflow, Sediment Discharge, and Water Quality in the Calabazas Creek Basin, Santa Clara County, California



U.S. DEPARTMENT OF THE INTERIOR
MARCH 3 1849

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations 78-2
Prepared in cooperation with the
Santa Clara Valley Water District

| | | | |
|---|---|---|---|
| **BIBLIOGRAPHIC DATA SHEET** | 1. Report No. | 2. | 3. Recipient's Accession No. |
| 4. Title and Subtitle<br>INTERIM REPORT ON STREAMFLOW, SEDIMENT DISCHARGE, AND WATER QUALITY IN THE CALABAZAS CREEK BASIN, SANTA CLARA COUNTY, CALIFORNIA | | | 5. Report Date<br>April 1978<br>6. |
| 7. Author(s)<br>J. M. Knott, G. L. Pederson, and R. F. Middelburg | | | 8. Performing Organization Rept. No. USGS/WRI 78-2 |
| 9. Performing Organization Name and Address<br>U.S. Geological Survey, Water Resources Division<br>California District<br>345 Middlefield Road<br>Menlo Park, California 94025 | | | 10. Project/Task/Work Unit No.<br>11. Contract/Grant No. |
| 12. Sponsoring Organization Name and Address<br>U.S. Geological Survey, Water Resources Division<br>California District<br>345 Middlefield Road<br>Menlo Park, California 94025 | | | 13. Type of Report & Period Covered<br>Interim<br>14. |

15. Supplementary Notes

Prepared in cooperation with the Santa Clara Valley Water District

16. Abstracts

Streamflow, sediment-discharge, and water-quality data were collected in an area of Santa Clara County, Calif., to determine base-line conditions prior to possibl urbanization. Most of the study area is nonurban (93 percent). Precipitation was representative of a very wet year (1973) and 2 years of above average rainfall (1974 and 1975). Most of the total annual sediment was transported during a few days each year. Maximum daily sediment discharge in a given year ranged from 23 to 62 percent of the annual total. Analyses of water quality indicated significant concentrations of certain heavy metals and pesticides during high flows. A parametric rainfall-runoff model was used to simulate discharge hydrographs at stations in the study area. Simulated values of runoff volume and peak discharge during observed storms were generally within 35 percent of values observed during large storms; simulation of small storms produced less satisfactory results.

17. Key Words and Document Analysis. 17a. Descriptors

*Model Studies, *Rainfall-Runoff Relationships, *Sediment Discharge, *Urbanization, California, Heavy Metals, Pesticides, Sediment Transport, Suspended Sediment, Water Quality

17b. Identifiers/Open-Ended Terms

Santa Clara County

17c. COSATI Field/Group

| | | |
|---|---|---|
| 18. Availability Statement<br>No restriction on distribution | 19. Security Class (This Report)<br>UNCLASSIFIED | 21. No. of Pages<br>47 |
| | 20. Security Class (This Page<br>UNCLASSIFIED | 22. Price |

# INTERIM REPORT ON STREAMFLOW, SEDIMENT DISCHARGE, AND WATER QUALITY IN THE CALABAZAS CREEK BASIN, SANTA CLARA COUNTY, CALIFORNIA

By J. M. Knott, G. L. Pederson, and R. F. Middelburg

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U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 78-2

Prepared in cooperation with the
Santa Clara Valley Water District

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April 1978

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

H. William Menard, Director

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For additional information write to:

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Water Resources Division
U.S. Geological Survey
345 Middlefield Rd.
Menlo Park, Calif. 94025

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## CONVERSION FACTORS

Metric units are used in this report, except for the contours of figure 1. For those readers who may prefer to use English units rather than metric units, the conversion factors for the units used in this report are listed below.

| *Metric* | *Multiply by* | *English* |
|---|---|---|
| $g/m^3$ (grams per cubic meter) | $6.242 \times 10^{-5}$ | $lb/ft^3$ (pounds per cubic foot) |
| km (kilometers) | $6.215 \times 10^{-1}$ | mi (miles) |
| $km^2$ (square kilometers) | $3.861 \times 10^{-1}$ | $mi^2$ (square miles) |
| m (meters) | 3.281 | ft (feet) |
| $m^2$ (square meters) | $1.076 \times 10^{1}$ | $ft^2$ (square feet) |
| $m^3$ (cubic meters) | $3.531 \times 10^{1}$ | $ft^3$ (cubic feet) |
| $m^3/s$ (cubic meters per second) | $3.531 \times 10^{1}$ | $ft^3/s$ (cubic feet per second) |
| mm (millimeters) | $3.937 \times 10^{-2}$ | in (inches) |
| t (tonnes) | 1.102 | tons (short) |
| $t/km^2$ (tonnes per square kilometer) | 2.855 | $ton/mi^2$ (tons per square mile) |

# INTERIM REPORT ON STREAMFLOW, SEDIMENT DISCHARGE, AND WATER QUALITY IN THE CALABAZAS CREEK BASIN, SANTA CLARA COUNTY, CALIFORNIA

By J. M. Knott, G. L. Pederson, and R. F. Middelburg

## SUMMARY AND RECOMMENDATIONS FOR FURTHER STUDY

Streamflow, sediment-discharge, and water-quality data are being collected in the Calabazas Creek basin, Santa Clara County, Calif., to determine annual water and sediment discharge at base-line conditions that are representative of a basin prior to urbanization. Results of the first 3 years of the study (1973-75) are given in this report.

Climatic conditions during this period were representative of a very wet year (1973) and 2 years of above-average rainfall (1974 and 1975).

Daily water and sediment discharge were monitored at three primary stations in the basin, and periodic measurements were made at five secondary stations during selected storms. Most of the total annual sediment discharge at each station was transported during a few days each year. Maximum daily sediment discharge in a given year ranged from 23 to 62 percent of the annual total. Daily water discharge at the gaging station Calabazas Creek at Rainbow Drive, near Cupertino (11169616), ranged from no flow to 3.31 $m^3/s$. Streamflow at this location was significantly augmented during low flow by diversion of water from the South Bay Aqueduct.

Annual sediment discharge at Calabazas Creek at Rainbow Drive (11169616) was 4,900 t in 1974 and 9,570 t in 1975. A large quantity of sediment was trapped in a debris basin at Comer Drive upstream from this station during both years. If this sediment had not been trapped, sediment discharge at the station would have been about 35 percent greater in 1974 and 30 percent greater in 1975. Most of the trapped sediment consists of sand and gravel that would probably have been deposited in the Calabazas Creek channel downstream from the station.

Monitoring of sediment transported by tributaries upstream from the debris basin at Comer Drive showed that Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga (11169588) probably transports eight or nine times as much sediment per square kilometer as other upstream tributaries. This tributary is apparently contributing 50 percent of the sediment trapped in the debris basin.

Analyses of water quality at primary stations suggested a classification of the streams as having magnesium-calcium bicarbonate or mixed-cation bicarbonate water. The water at all stations varied from moderately hard at medium to high flows to very hard at low flows.

Significant concentrations of chromium, mercury, and lead were detected during some high flows. Pesticides were found in insignificant concentrations at two upstream stations (11169580 and 11169600). Significant concentrations of pesticides were found during high flows at Calabazas Creek at Rainbow Drive (11169616).

Annual surveys of stream-channel geometry at 14 sites showed that changes in relative depth and bed elevation in rural areas were of the same general magnitude as those in urban areas. Large changes in the channel were observed at two sites (C5 and C6) upstream from the debris basin at Comer Drive.

Hydrologic data collected at one precipitation station (11169575) and two water discharge stations (11169580 and 11169600) were used to simulate rainfall-runoff characteristics. Two existing simulation models were combined and modified to define hydrologic conditions in the Calabazas Creek basin. The resulting model is based largely on antecedent-moisture accounting, infiltration, and the physical characteristics of the basin. Simulated values of runoff volume and peak discharge during observed storms were generally within 35 percent of observed values during large storms. Simulation of small storms produced less satisfactory results.

Because urban development in the basin during the period 1973-75 was less than that anticipated at the beginning of the study, few changes in the hydrology of the basin were observed. The scope of the study could, therefore, be reduced substantially.

Early emphasis should be placed on collecting data needed to complete an adequate definition of base-line conditions in the Calabazas Creek basin. Work suggested through the 1978 fiscal year would include:

1. Operation of the rainfall and streamflow stations.
2. Monitoring of sediment discharge at primary and secondary stations during selected storm periods.
3. Water-quality monitoring at primary stations.

After the 1978 fiscal year, the study should be oriented toward using information already obtained to estimate probable effects of urbanization in other areas in Santa Clara County. In the event that urbanization in the Calabazas Creek basin increases significantly in the future, consideration should be given to documenting any changes in the hydrology of the basin.

# INTRODUCTION

Since the end of World War II, urbanization has proceeded at a rapid pace throughout much of Santa Clara County, Calif. In recent years urban development has spread from the flat valley areas into the foothills, where erosion problems are likely to be more severe. Future development in the foothills, associated with an increase in impervious area, could result in increased flooding in downstream urban areas. Excavation at development sites could result in accelerated erosion in foothill areas and subsequent sediment deposition in storm drains and at sites where gradients are reduced. In addition, the water quality in existing urban areas may change with increased urbanization.

The objectives of this study are to:

1. Document changes in water and sediment discharge and water-quality characteristics that are associated with urban development in the Calabazas Creek basin (fig. 1).
2. Estimate the probable effects of urbanization on the hydrology of other areas in Santa Clara County.
3. Provide regional planners with reliable criteria for designing future developments in foothill areas.

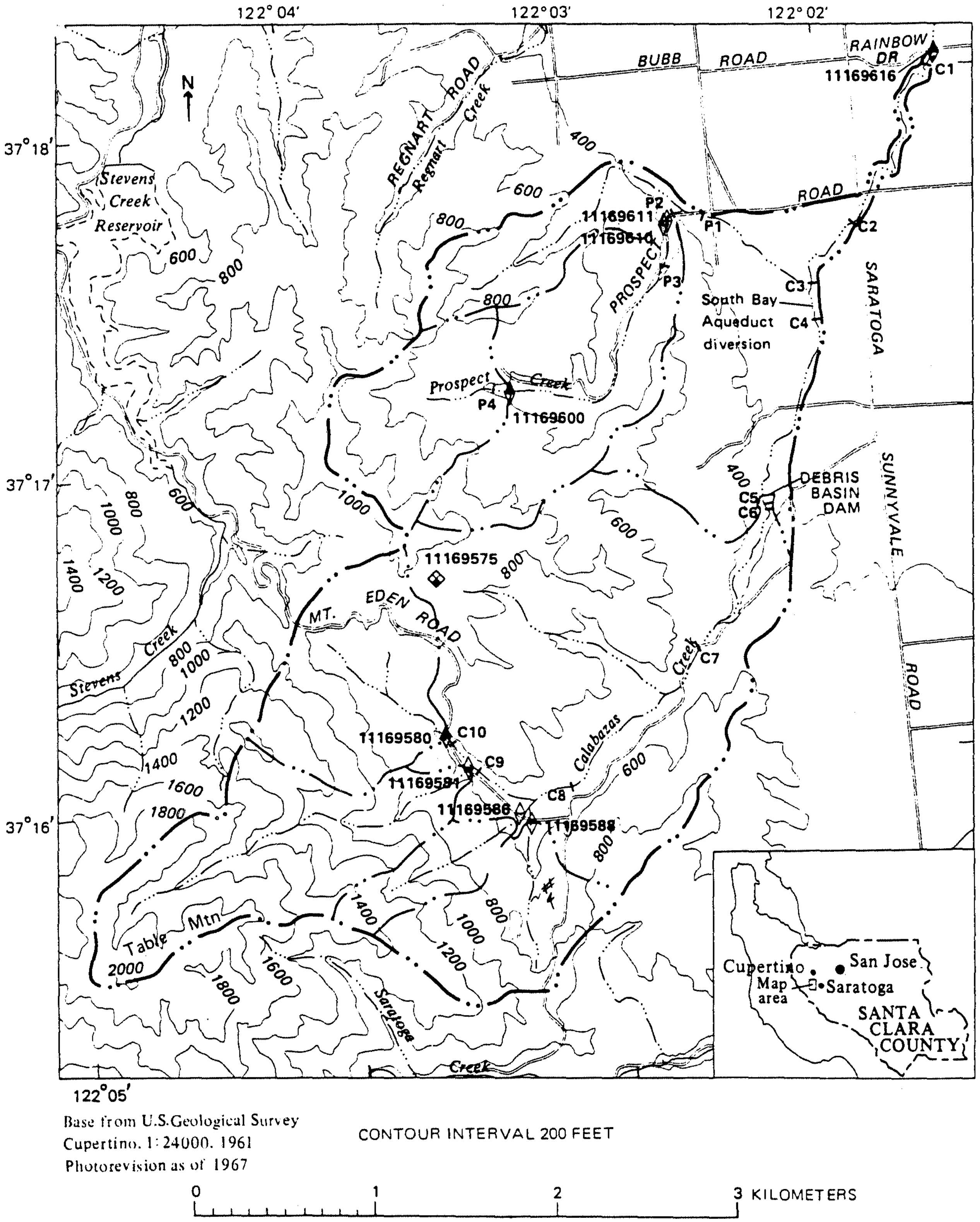
This report, prepared in cooperation with the Santa Clara Valley Water District, is a summary of hydrologic data obtained during the initial 3 years of the study (1973-75). All years referred to in this report are water years, unless otherwise noted. A water year is the 12-month period October 1 through September 30 and is designated by the calendar year in which it ends.

# DESCRIPTION OF THE AREA

## General Features

The Calabazas Creek basin, as referred to in this report, includes the 10.31-$km^2$ drainage area upstream from the gaging station Calabazas Creek at Rainbow Drive, near Cupertino (station 11169616, fig. 1). The basin lies in the western foothills of the Santa Clara Valley near Cupertino, Saratoga, and western San Jose. The terrain is moderately steep, with elevations ranging from about 80 m at Rainbow Drive to about 600 m at Table Mountain.

The major tributary of Calabazas Creek is Prospect Creek, which is in the northern part of the basin. All other tributaries in the basin are unnamed. Calabazas Creek and its tributaries are intermittent streams.



Base from U.S. Geological Survey
Cupertino. 1:24000. 1961
Photorevision as of 1967

CONTOUR INTERVAL 200 FEET

FIGURE 1.--Hydrologic-data monitoring stations and channel-geometry survey sites in the Calabazas Creek basin.

## EXPLANATION

U.S. GEOLOGICAL SURVEY SURFACE WATER AND SEDIMENT STATION LOCATION AND NUMBER

| | |
|---|---|
| **11169600** ▲ | Continuous-record gaging station |
| **11169581** △ | Measurement station without a gage |
| **11169586** ▽ | Sediment-measurement station |
| **11169575** ◈ | PRECIPITATION STATION AND NUMBER |
| **C8** ⸜ | SURVEYED CHANNEL CROSS-SECTION SITE AND LETTER AND NUMBER– P, Prospect Creek subbasin; C, Calabazas Creek basin |
| —— • • —— | BASIN BOUNDARY |
| —— • —— | SUBBASIN BOUNDARY |

At the outset of this study (1973) most of the basin was rural in character (fig. 2), with the area covered by rangeland and forest land (47 percent), orchards and vineyards (35 percent), and cropland or pasture (10 percent). About 6 percent of the area was urbanized. About 200 homes are scattered throughout the foothills. The rest of the basin (2 percent) consists of a golf course, some small ponds, and several gravel pits. Between 1973 and 1975 a small additional part of the basin became urbanized (less than 1 percent).

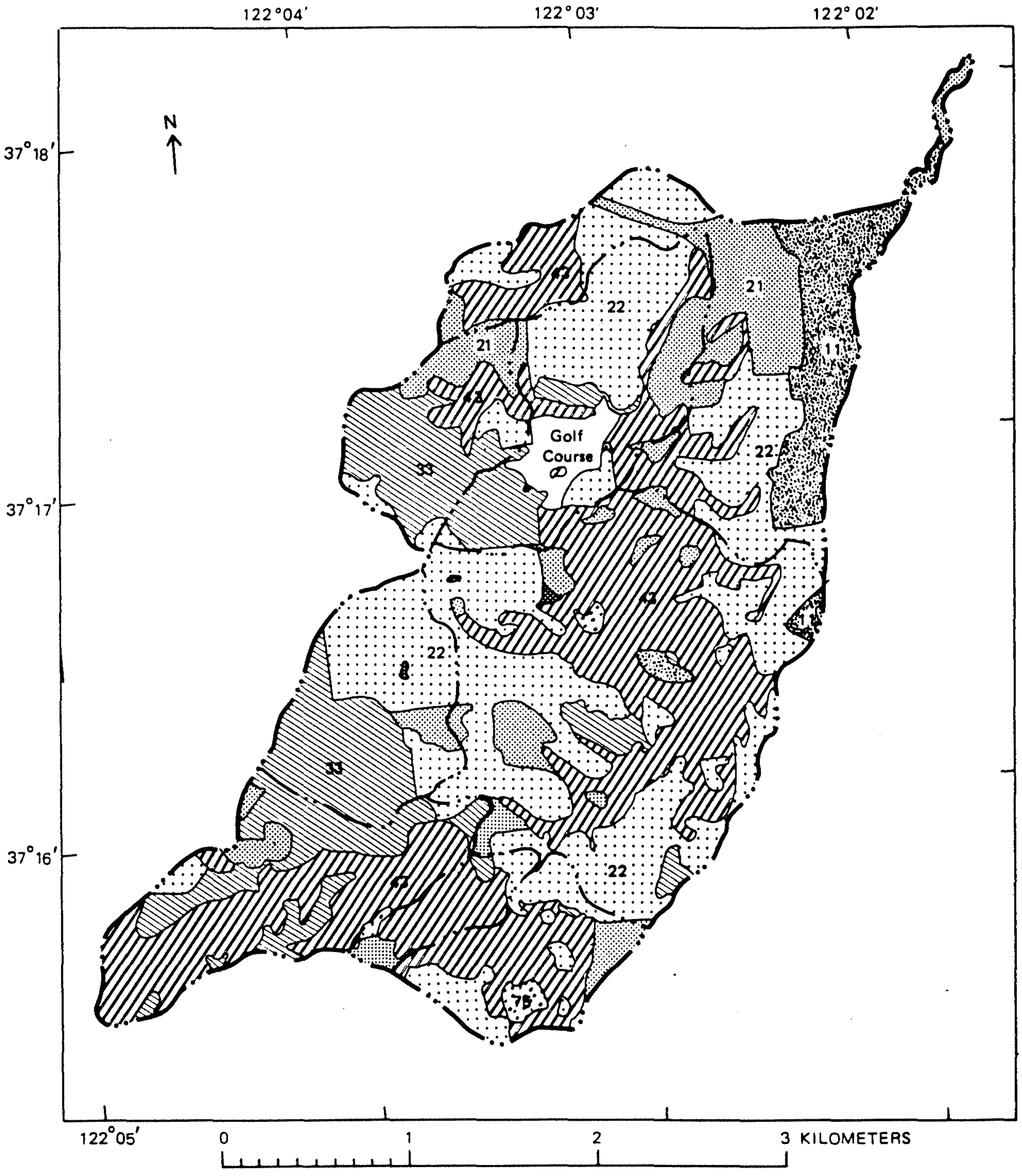


FIGURE 2.--Generalized land use, 1973.
[Land-use classifications and numbers from Anderson and others, 1976]

**EXPLANATION**

LAND USE

| | |
|---|---|
| 11 | Urban or Built-up land – Residential |
| 21 | Agricultural Land – Cropland and pasture |
| 22 | Agricultural Land – Orchard and vineyard |
| 33 | Rangeland – Mixed rangeland |
| 43 | Forest Land – Mixed forest land |
| 53 | Water – Reservoir |
| 76 | Barren Land – Gravel pit |

—— • • —— Basin boundary

—— • • —— Subbasin boundary

## Geology

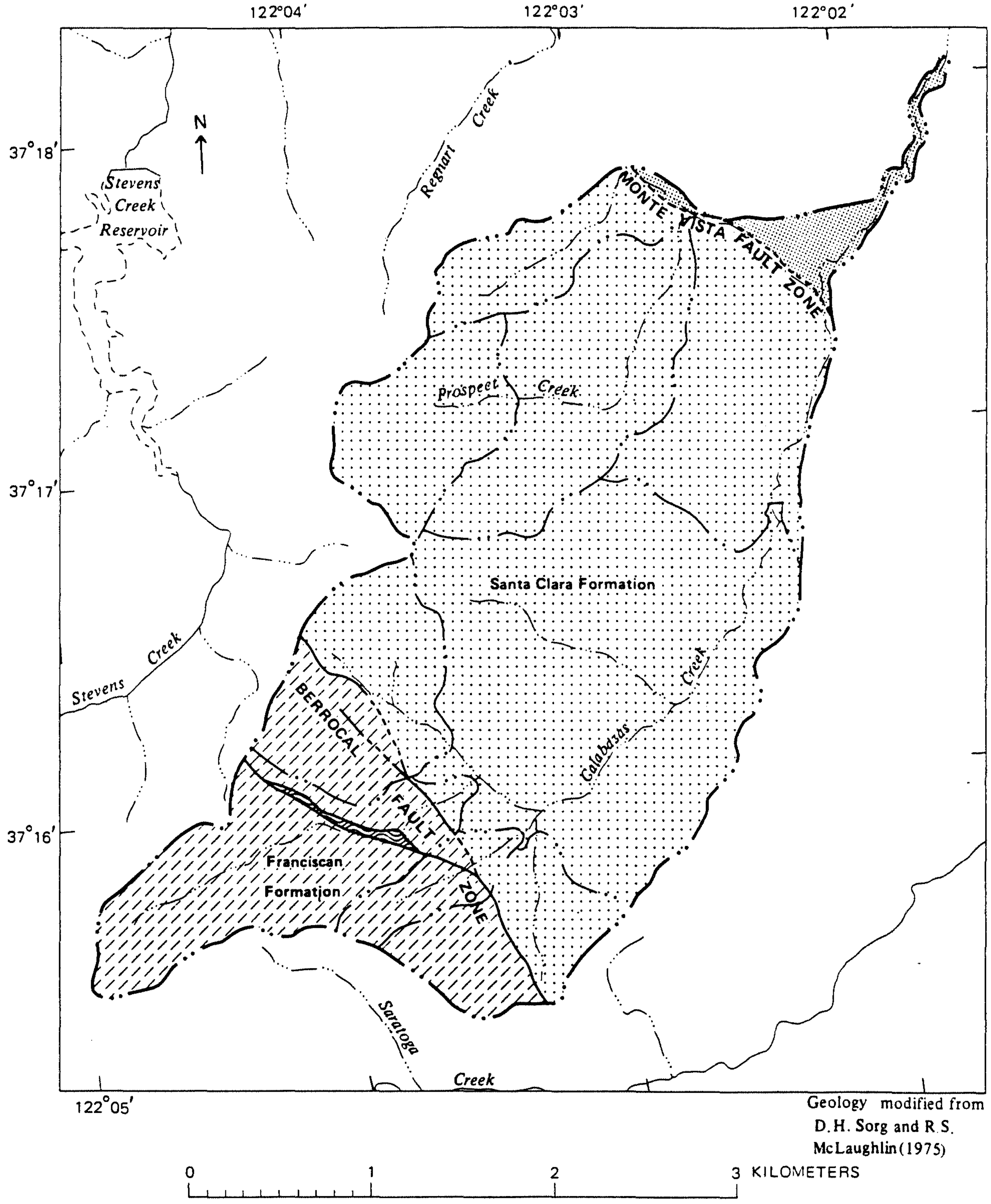
Geologic maps by Sorg and McLaughlin (1975) indicate that the Calabazas Creek basin upstream from Rainbow Drive is underlain primarily by the Franciscan and Santa Clara Formations, separated by the Berrocal fault (fig. 3).

The Franciscan Formation ranges in age from Late Jurassic to Late Cretaceous and includes rock units of metashale, metagraywacke, and greenstone. Soils are generally shallow, and rock outcrops are prominent at many locations. Landslide areas within the Franciscan Formation are locally significant in shear zones and near faults. Serpentinized rocks occur as pervasively sheared lenticular bodies within fault and shear zones cutting the Franciscan Formation.

The Santa Clara Formation is late Pliocene to early Pleistocene in age and consists of semiconsolidated to moderately lithified conglomerate, sandstone, siltstone, and mudstone. Landslide deposits are abundant in areas underlain by the Santa Clara Formation, especially where soils are underlain by poorly consolidated siltstone and mudstone. Soils are generally deep and well drained.

Alluvial fan deposits occur in the lower part of the basin. These deposits generally consist of poorly sorted gravel, sand, silt, and clay.

A generalized distribution of the Franciscan and Santa Clara Formations and the downstream alluvium is shown in figure 3. The many landslides and minor alluvial deposits are not shown. Only the major outcrop of serpentinite is shown.



Geology modified from D.H. Sorg and R.S. McLaughlin (1975)

FIGURE 3.--Generalized geology.

**EXPLANATION**

▒ ALLUVIAL FAN DEPOSITS–Quaternary
⁘ SANTA CLARA FORMATION – Quaternary and Tertiary
≋ SERPENTINITE – Tertiary and Cretaceous
▨ FRANCISCAN FORMATION – Cretaceous and Jurassic
——— - - - - Fault – Short dashed where inferred
——— • • ——— Basin boundary
——— • • ——— Subbasin boundary

# HYDROLOGY

## Precipitation

Precipitation in the Calabazas Creek basin is generally moderate to heavy during the winter storm season (November through March) and is light to nonexistent during the rest of the year. Precipitation is almost entirely in the form of rainfall, although snow occasionally falls at the highest elevations. Average annual rainfall is less than 460 mm in the lower part of the basin and more than 890 mm on Table Mountain (Santa Clara Valley Water District, written commun., 1976).

A nonrecording precipitation station has been operated at Garrod Ranch (11169575, fig. 1) since 1935. A recording gage was installed in October 1972. Rainfall is recorded in 5-minute time increments during the storm season and in 15-minute time increments during the rest of the year. Rainfall data at this station are used as an input component for rainfall-runoff simulation of stormflows in the basin. The station is at an elevation of about 274 m and intercepts an average annual rainfall of 660 mm.

Annual rainfall at the Garrod Ranch station was about 40 percent above average in 1973 and about 10 percent above average in 1974 and 1975 (table 1).

TABLE 1.--*Precipitation and water discharge at hydrologic stations*

| Station number and name | Drainage area (km$^2$) | Water year | Precipitation | | Water discharge | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Annual (mm) | Maximum daily (mm) | Annual | | Maximum daily | |
| | | | | | m$^3$ | mm | m$^3$/s | mm |
| 11169575 Garrod Ranch near Saratoga | - | 1973 | [1]943 | 75 | - | - | - | - |
| | | 1974 | [1]631 | 84 | - | - | - | - |
| | | 1975 | 723 | 91 | - | - | - | - |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | 0.96 | 1973 | - | - | 572,000 | 598 | 0.62 | 56 |
| | | 1974 | - | - | 275,000 | 288 | .28 | 26 |
| | | 1975 | - | - | 303,000 | 317 | .76 | 69 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | .70 | 1973 | - | - | 238,000 | 341 | .24 | 29 |
| | | 1974 | - | - | 105,000 | 150 | .10 | 13 |
| | | 1975 | - | - | 117,000 | 168 | .19 | 23 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | 10.31 | 1973 | - | - | [2]4,750,000 | [2]460 | [2]3.31 | 28 |
| | | 1974 | - | - | [2]2,700,000 | [2]262 | [2]2.01 | 17 |
| | | 1975 | - | - | [2]2,580,000 | [2]250 | [2]3.03 | 25 |

[1] Minimum precipitation, recorder malfunction during some periods.

[2] Includes diversion flows from South Bay Aqueduct.

## Streamflow

Streamflow throughout the basin is generally unregulated during storm periods. During periods of low flow, however, a considerable amount of water (about 2,500,000 $m^3$ annually) is diverted into the basin from the South Bay Aqueduct (part of the California State Water Project) to percolate water into various aquifers in the Santa Clara Valley. This diverted water is discharged into Calabazas Creek (fig. 1) about 1.6 km upstream from the gaging station at Rainbow Drive (11169616) at a daily mean flow rate generally ranging from 1 to 2 $m^3/s$, which is significantly reduced by percolation before reaching the gaging station.

At the outset of the study, three continuous-record gaging stations were designated as primary stations (fig. 1). One, Calabazas Creek at Rainbow Drive, near Cupertino (11169616), had been operated by the Santa Clara Valley Water District since 1966. Two others, Calabazas Creek tributary at Mt. Eden Road, near Saratoga (11169580), and Prospect Creek at Saratoga Golf Course, near Saratoga (11169600), were established in October 1972 for this study. In addition, periodic measurements of water discharge were made at various secondary stations (fig. 1). Stream discharge measurements are published annually (U.S. Geological Survey, 1973a, 1974a, and 1975).

An examination of runoff data in table 1 indicates that the subbasin above the Calabazas Creek tributary station (11169580) contributes about 80 percent more runoff than the subbasin above the Prospect Creek station (11169600). Average annual rainfall over the former subbasin, however, is only 14 percent larger than that of the Prospect Creek subbasin. This comparison suggests that infiltration characteristics of the two subbasins are different, with a much smaller part of total rainfall in the Prospect Creek subbasin being discharged as surface runoff. Maximum daily water discharge for the Prospect Creek station (11169600) is also much smaller than that for the Calabazas Creek tributary station (11169580).

Infiltration of rainfall in the area between the upstream stations and the Rainbow Drive station is also large. Variability of infiltration in the subbasins and streamflow characteristics will be discussed in the section on rainfall-runoff simulation.

# SEDIMENT DISCHARGE

## Sediment Transport in the Basin

More than half the sediment transported in the basin is derived from sheet erosion of hillsides and channel erosion during winter rainstorms. Cultivated areas, construction sites, landslides, and rock slides are major local sources of sediment in areas where bare soil is exposed and where hillslopes are steep.

The quantity of sediment transported depends largely on the particle size of sediment, streamflow characteristics, and the available supply of sediment. Transported sediment includes particles moved in suspension by the flowing water (suspended-sediment discharge) and the coarser particles that move along or near the bed of the stream (bedload discharge). Silt and clay are carried in suspension; pebbles and coarser particles are generally transported as bedload. Sand may be transported either in suspension or as bedload. Coarse sediment (sand and gravel) is commonly transported with ease by the foothill streams where gradients are large but tends to be deposited in the stream channels in valley areas where gradients are smaller. Because urbanized areas are located predominantly in the valley part of the Calabazas Creek basin, where stream gradients are smaller than in foothill areas, accelerated erosion in the foothills would be expected to result in an increase of coarse sediment deposits in urban stream channels and a reduction in channel capacity.

## Data Collection

Sediment discharge data were collected at eight stations in the basin (fig. 1) during the 1973-75 water years. These data consisted of daily records of total sediment discharge at three primary stations, where water discharge data were being collected, and periodic samples of suspended-sediment and total sediment discharge at five secondary stations. Two of the primary gaging stations, Calabazas Creek tributary at Mt. Eden Road, near Saratoga (11169580) and Prospect Creek at Saratoga Golf Course, near Saratoga (11169600), were used to define annual sediment yields (sediment quantity per square kilometer of basin) that were representative of foothill areas prior to urbanization. A primary sediment station was established at the gaging station Calabazas Creek at Rainbow Drive, near Cupertino (11169616), in 1974 to determine the sediment yields for an area containing urban development and to evaluate the effect of a debris basin which was constructed at Comer Drive during the summer 1973.

Periodic samples were collected at various secondary stations (fig. 1) to determine if sediment yields throughout the basin were uniform or if any tributaries were transporting unusually large or small quantities of sediment relative to the primary stations. Samples were collected during one or two storms per year. The secondary stations include: Calabazas Creek at Mt. Eden Road, near Saratoga (11169581); Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga (11169586); Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga (11169588); Prospect Creek at Maria Lane, near Saratoga (11169610); and Prospect Creek tributary near Saratoga (11169611).

Sediment samples at all stations were collected with standard depth-integrating suspended-sediment samplers (U.S. Inter-Agency Committee on Water Resources, 1963). Samples were collected at selected verticals in the stream cross section to determine the average sediment concentration and particle-size distribution of sediment in the water-sediment mixture.

Sediment transported throughout the depth of the stream (total sediment) was sampled using suspended-sediment samplers and bedload samplers (Helley and Smith, 1971, p. 1-18). Two techniques were used to sample total sediment discharge (fig. 4).

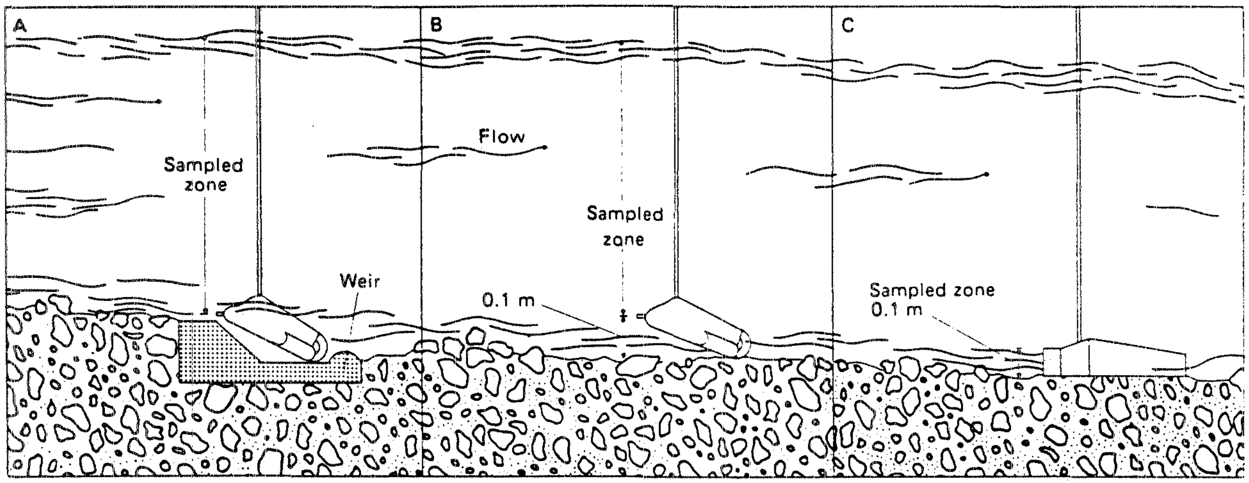


FIGURE 4.--Sampling zones of various sediment samplers.

The first technique (fig. 4*A*), which was used at culverts and at sites where a concrete weir had been installed in the stream, employed a suspended-sediment sampler and was used during low to intermediate flows when the stream was transporting sediment particles finer than 4.0 mm, two-thirds the diameter of the sampler nozzle. Samples were integrated through the total depth of the stream between the water surface and the weir using only the suspended-sediment sampler.

A second technique was used during high flows when the weir was inaccessible because of high stream velocities and excessive water depths. Sediment in the sampled zone (fig. 4*B*) was obtained with a suspended-sediment sampler, and sediment in the bottom 0.1 m was obtained with a bedload sampler (fig. 4*C*). In this report, bedload is considered to consist of particles in transit within 0.1 m of the streambed. Total sediment discharge was obtained as the sum of bedload discharge and suspended-sediment discharge. A trap efficiency coefficient of 1.0 was assumed for the bedload sampler, which has not yet been calibrated.

## Sediment Records at Primary Stations

Sediment data obtained during the initial 3 years of the study (1973-75) indicate that the annual quantity of sediment transported at each primary station is extremely variable and depends largely on the length and intensity of individual storms. Runoff during a few large storms each year generally transports a major part of the annual sediment discharge. A comparison of data in table 2 shows that the maximum daily total sediment discharge in a given year ranges from 23 to 62 percent of the annual total. Also, the quantity of sediment transported during 1 day in a wet year may be as large or larger than the sediment transported during 1 or more dry years.

TABLE 2.--*Total sediment discharge and yield at primary stations*

| Station number and name | Drainage area (km$^2$) | Water year | Sediment discharge, in tonnes | | | | Annual sediment yield (t/km$^2$) | Percent sand and gravel |
|---|---|---|---|---|---|---|---|---|
| | | | Annual | | | Maximum daily (total) | | |
| | | | Silt-clay | Sand-gravel | Total | | | |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | 0.96 | 1973 | 833 | 533 | 1,370 | 327 | 1,430 | 39 |
| | | 1974 | 324 | 200 | 524 | 190 | 546 | 38 |
| | | 1975 | 425 | 310 | 735 | 363 | 766 | 42 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | .70 | 1973 | 548 | 477 | 1,030 | 289 | 1,470 | 46 |
| | | 1974 | 73 | 66 | 139 | 49 | 199 | 47 |
| | | 1975 | 176 | 144 | 320 | 200 | 457 | 45 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | 10.31 | 1974 | 3,200 | 1,700 | 4,900 | 1,120 | 475 | 35 |
| | | 1975 | 6,850 | 2,720 | 9,570 | 3,750 | 928 | 28 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino[1] | 10.31 | 1974 | 3,500 | 4,170 | 7,670 | - | 744 | 54 |
| | | 1975 | 6,880 | 7,650 | 14,500 | - | 1,410 | 47 |

[1] Sediment discharge and yield including sediment deposited in debris basin at Comer Drive.

Total sediment yields for the period 1973-75 are representative of 1 year of very high rainfall (1973) and 2 years of above-average rainfall (1974 and 1975). Annual yields at the primary stations ranged from 199 to 1,470 t/km$^2$. Both extremes were observed at the Prospect Creek station (11169600). Annual yields at Calabazas Creek at Rainbow Drive (11169616) are comparable to those at Calabazas Creek tributary at Mt. Eden Road (11169580) for the years 1974 and 1975.

Total sediment yields for Calabazas Creek at Rainbow Drive (11169616), however, are representative only of sediment transported past the station and do not include sediment trapped by a debris basin at Comer Drive (fig. 1). The yield of the Rainbow Drive station is adjusted to include sediment in the debris basin.

A breakdown of total sediment discharge into fine sediment (silt-clay) and coarse sediment (sand-gravel) indicates that coarse sediment accounts for a large percentage (38 to 47 percent) of the annual total sediment discharge at Calabazas Creek tributary at Mt. Eden Road (11169580) and Prospect Creek at Saratoga Golf Course (11169600). Coarse sediment at Calabazas Creek at Rainbow Drive (11169616) was significantly less (28 to 35 percent) (table 2).

If sediment deposited in the debris basin is included with sediment passing the Rainbow Drive station, the total sediment yield of Calabazas Creek at Rainbow Drive (11169616) would be considerably larger than that of stations in the foothills. The percentage of coarse sediment would also be increased (from 28-35 percent to 47-54 percent).

## Relation Between Total Sediment Discharge and Water Discharge

A common method for studying sediment-transport characteristics at individual stations is to construct a graph of sediment discharge versus water discharge. This relation is generally expressed as a plot on logarithmic paper and is referred to as a sediment-transport curve. Sediment-transport curves for primary stations in the Calabazas Creek basin were obtained by averaging values of daily total sediment discharge within a narrow range of daily mean water discharge. For example, all values of daily mean water discharge ranging from 0.5 to 0.6 m$^3$/s were averaged and, together with the average sediment discharge for concurrent days, resulted in one plotted point. Each plotted point shown in figures 5-7 may represent 1 day or the average of a group of days of sediment and water discharge during a given year.

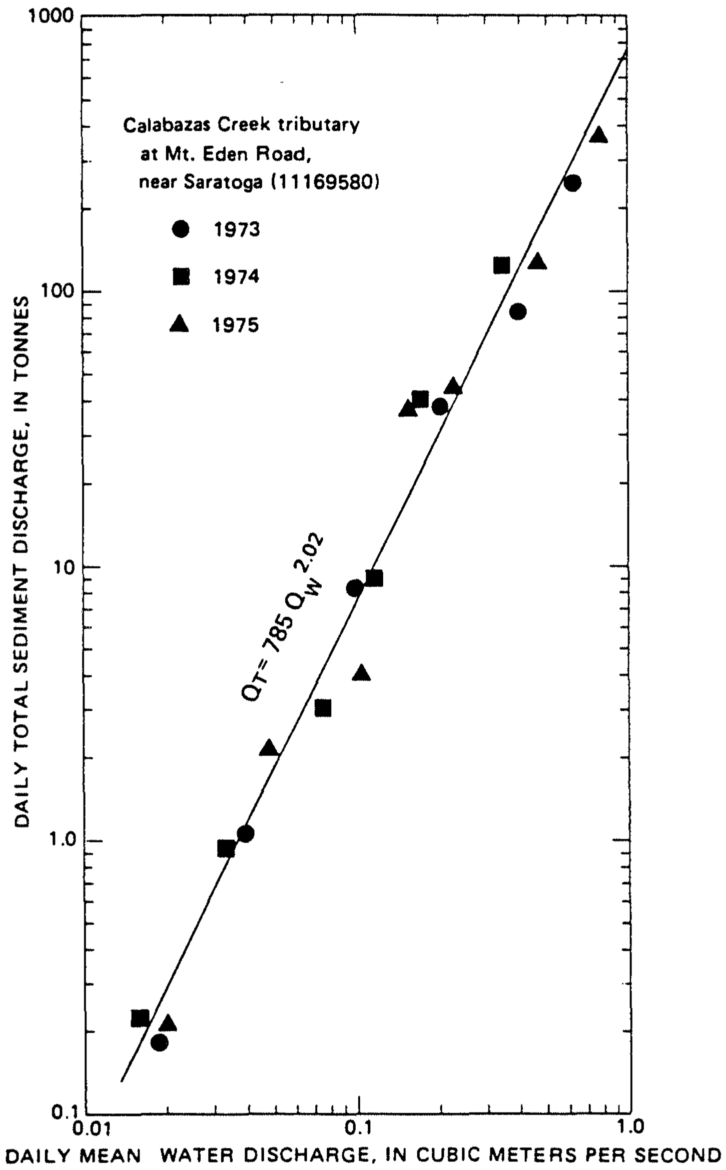


FIGURE 5.--Relation of total sediment discharge to water discharge at Calabazas Creek tributary at Mt. Eden Road, near Saratoga, 1973-75.

Sediment-transport curves for each of the primary stations can be expressed by the following empirical equations for given ranges of water discharge:

1. Calabazas Creek tributary at Mt. Eden Road (11169580)

$$Q_T = 785\, Q_W^{2.02},\ 0.01<Q_W<1.0 \qquad (1)$$

2. Prospect Creek at Saratoga Golf Course (11169600)

$$Q_T = 6410\, Q_W^{2.34},\ 0.01<Q_W<0.40 \qquad (2)$$

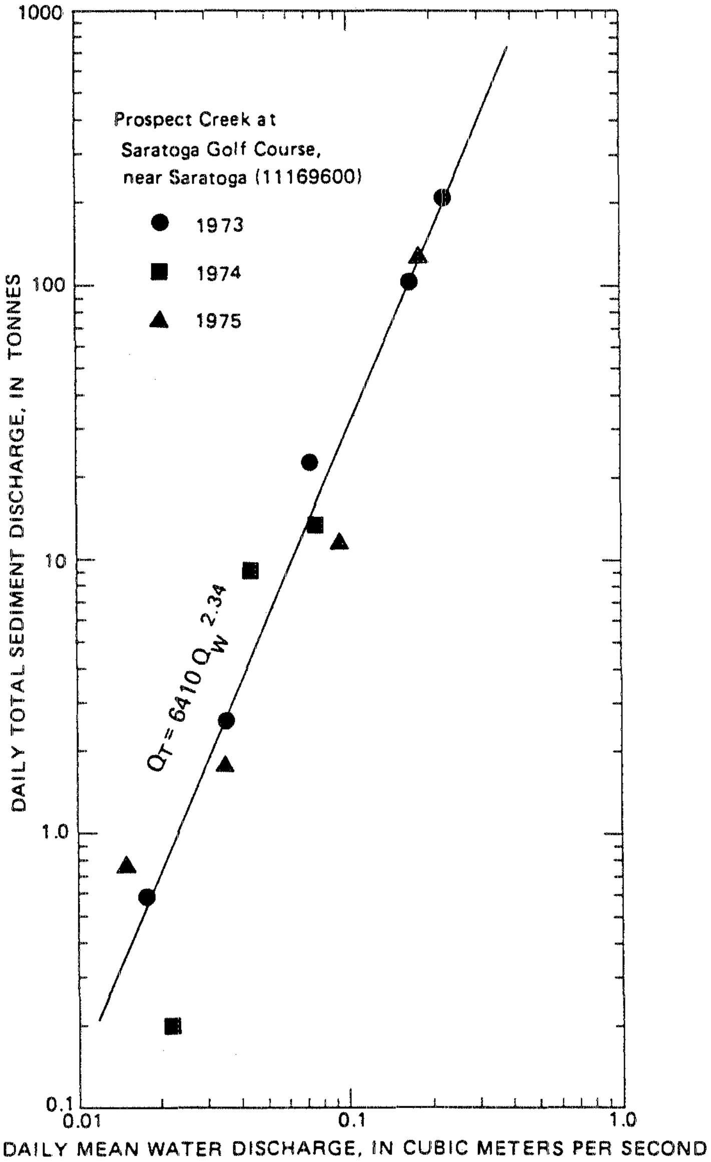


FIGURE 6.--Relation of total sediment discharge to water discharge at Prospect Creek at Saratoga Golf Course, near Saratoga, 1973-75.

3. Calabazas Creek at Rainbow Drive (11169616)

$$Q_T = 10.6\, Q_W^{1.13},\ 0.01<Q_W<0.10 \qquad (3)$$

$$Q_T = 374\, Q_W^{1.90},\ 0.20<Q_W<4.0 \qquad (4)$$

where $Q_T$ = daily total sediment discharge, in tonnes, and

$Q_W$ = daily mean water discharge, in cubic meters per second.

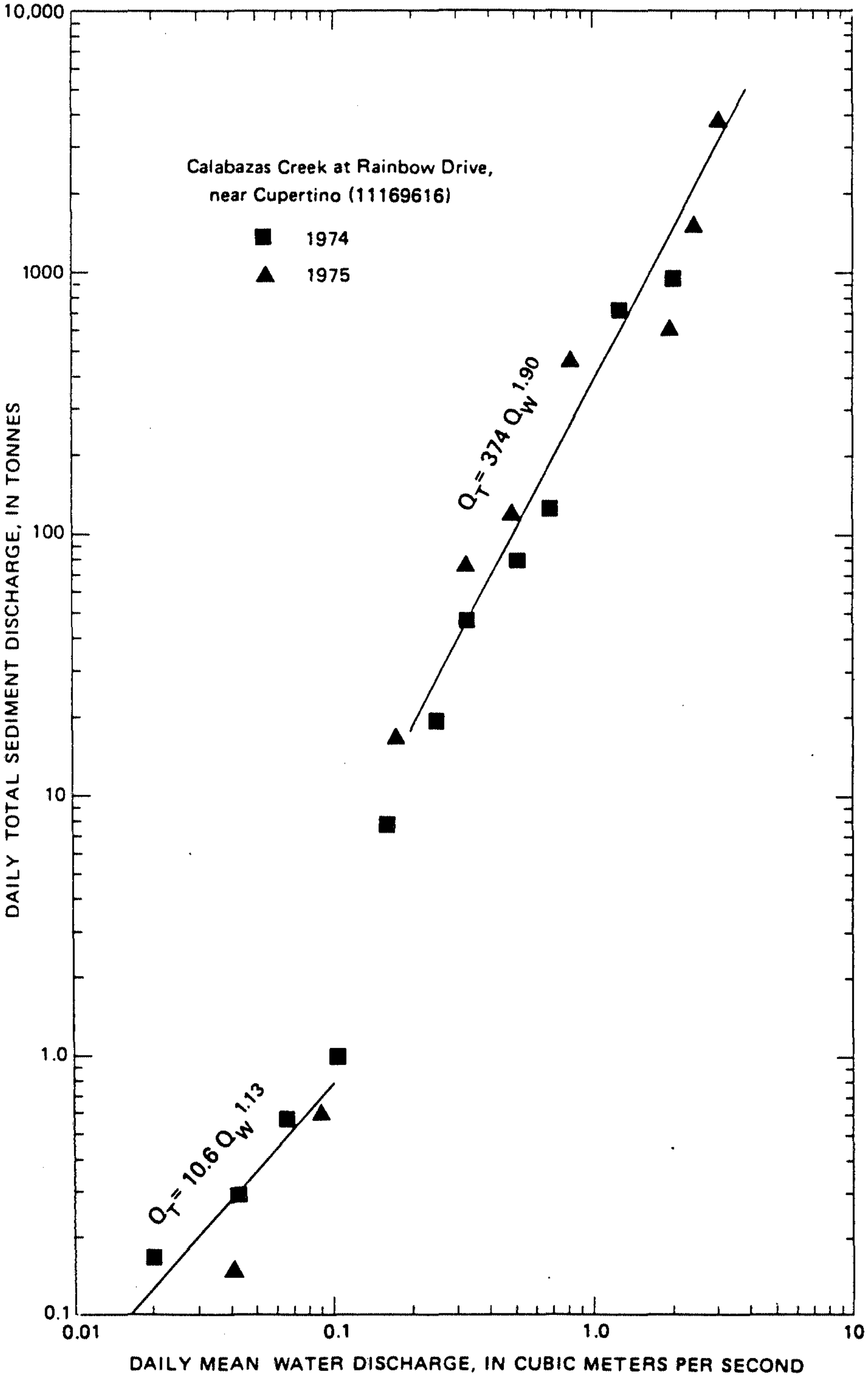


FIGURE 7.--Relation of total sediment discharge to water discharge at Calabazas Creek at Rainbow Drive, near Cupertino, 1974-75.

The location of data points for each year relative to the average curve shows no indication of a significant change in sediment-transport characteristics from one year to the next. Thus, no significant change in the physical characteristics of the subbasins upstream from the stations is assumed.

Two distinct sediment-transport curves are indicated for Calabazas Creek at Rainbow Drive (fig. 7). Daily flows larger than 0.20 $m^3/s$ are generally the result of storm events, and the slope of the curve is similar to that for the Calabazas Creek tributary and Prospect Creek stations. With increasing flow, total sediment discharge increases by an exponential rate of about 2 relative to that of water discharge.

Daily flows less than 0.10 $m^3/s$ are largely the result of low-flow diversion from the South Bay Aqueduct, originating about 1.6 km upstream. The channel of Calabazas Creek above the diversion point is usually dry, and sediment transported past the Rainbow Drive station represents material eroded from the channel. Daily flows between 0.10 and 0.20 $m^3/s$ are probably representative of a mixture of stormflow and diversion flow.

## Total Sediment Yield at Secondary Stations

Sediment samples were collected at secondary stations in the basin to determine if any individual tributaries were transporting unusually large quantities of sediment relative to that at primary sediment stations or if sediment yields were uniform throughout the basin. Individual samples were analyzed for total-sediment concentration and particle-size distribution (U.S. Geological Survey, 1973b, 1974b, 1975). The quantity of sediment transported at secondary stations was determined for five storm periods (table 3). Average water discharge during the storms was synthesized using the rainfall-runoff model (see "Hydrologic Simulation") and discharge measurements.

To facilitate a comparison of the relative quantity of sediment transported at various stations throughout the basin, the data in table 3 were summarized in terms of total sediment yield and as a ratio between the total sediment yield at a given station and that of a primary station (table 4). Calabazas Creek tributary at Mt. Eden Road (11169580) was chosen as an index station because its drainage area contained no urban development and was underlain by both of the principal geologic formations in the Calabazas Creek basin--the Franciscan and the Santa Clara.

Sediment data in tables 3 and 4 represent two large storms (rainfall greater than 50 mm) and three small storms (rainfall less than 20 mm) that occurred during 1973-75. Although the number of storms sampled is small, some general sediment yield characteristics typical of each storm are apparent.

TABLE 3.--*Average water discharge and total sediment discharge at storm-sampling stations, 1973-75*

| Station number and name | Storm date and size | Drainage area (km$^2$) | Average water discharge (m$^3$/s) | Sediment discharge, in tonnes | | |
|---|---|---|---|---|---|---|
| | | | | Silt-clay | Sand-gravel | Total |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | January 16, 1973 (large) | 0.96 | 0.85 | 182 | 133 | 315 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .70 | .31 | 170 | 165 | 335 |
| 11169610 Prospect Creek at Maria Lane, near Saratoga | | 1.97 | .62 | 244 | 120 | 364 |
| 11169611 Prospect Creek tributary near Saratoga | | .04 | .008 | .15 | .04 | .19 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | March 6, 1973 (small) | .96 | .16 | 9.1 | 3.6 | 13 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | 1.27 | .043 | .38 | .10 | .48 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .28 | .018 | .05 | .05 | .10 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | .67 | .059 | 3.6 | 7.3 | 11 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .70 | .024 | 1.1 | .34 | 1.4 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | January 16, 1974 (small) | .96 | .040 | .24 | .01 | .25 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | 1.27 | .018 | .15 | .01 | .16 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .28 | .010 | .07 | 0 | .07 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | .67 | .042 | 11 | 24 | 35 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .70 | .005 | .03 | 0 | .03 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 10.31 | .21 | 15 | 5.1 | 20 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | February 13, 1975 (small) | .96 | .10 | .54 | .36 | .90 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | 1.27 | .062 | .21 | .04 | .25 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .28 | .025 | .32 | .03 | .35 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | .67 | .091 | 12 | 51 | 63 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .70 | .022 | .05 | 0 | .05 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 10.31 | .42 | 15 | 2.2 | 17 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | March 7, 1975 (large) | .96 | .79 | 42 | 40 | 82 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | 1.27 | .51 | 43 | 55 | 98 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .28 | .16 | 12 | 15 | 27 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | .67 | .45 | 108 | 142 | 250 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .70 | .21 | 15 | 13 | 28 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 10.31 | 3.65 | 504 | 230 | 734 |

TABLE 4.--*Comparison of total sediment yield at storm-sampling stations, 1973-75*

| Station number and name | Storm date and size | Sediment yield: Silt-clay: Tonnes per square kilometer | Silt-clay: Ratio[1] | Sand-gravel: Tonnes per square kilometer | Sand-gravel: Ratio[1] | Total: Tonnes per square kilometer | Total: Ratio[1] | Percent sand and gravel |
|---|---|---|---|---|---|---|---|---|
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | January 16, 1973 (large) | 190 | 1.0 | 139 | 1.0 | 329 | 1.0 | 42 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | 243 | 1.3 | 236 | 1.7 | 479 | 1.5 | 49 |
| 11169610 Prospect Creek at Maria Lane, near Saratoga | | 124 | .7 | 61 | .4 | 185 | .6 | 33 |
| 11169611 Prospect Creek tributary near Saratoga | | 3.8 | .02 | 1.0 | .01 | 4.8 | .01 | 21 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | March 6, 1973 (small) | 9.5 | 1.0 | 3.8 | 1.0 | 13 | 1.0 | 28 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | .30 | .03 | .08 | .02 | .38 | .03 | 21 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .18 | .02 | .18 | .05 | .36 | .03 | 50 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | 5.4 | .6 | 11 | 2.9 | 16 | 1.2 | 66 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | 1.6 | .2 | .49 | .1 | 2.1 | .2 | 24 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | January 16, 1974 (small) | .25 | 1.0 | .01 | 1.0 | .26 | 1.0 | 4 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | .12 | .5 | .01 | 1.0 | .13 | .5 | 6 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | .25 | 1.0 | 0 | - | .25 | 1.0 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11169588 Calabazas Creek tributary No. 4, at Mt. Eden Road, near Saratoga | | 16 | 64 | 36 | 3,600 | 52 | 200 | 69 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .04 | .2 | 0 | - | .04 | .2 | 0 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 1.5 | 6.0 | .49 | 49 | 2.0 | 7.7 | 26 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | February 13, 1975 (small) | .56 | 1.0 | .38 | 1.0 | .94 | 1.0 | 40 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | .17 | .3 | .03 | .08 | .20 | .2 | 16 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | 1.1 | 2.0 | .11 | .3 | 1.2 | 1.3 | 9 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | 18 | 32 | 76 | 200 | 94 | 100 | 81 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | .07 | .1 | 0 | - | .07 | .07 | 0 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 1.5 | 2.7 | .21 | .6 | 1.7 | 1.8 | 13 |
| 11169580 Calabazas Creek tributary at Mt. Eden Road, near Saratoga | March 7, 1975 (large) | 44 | 1.0 | 42 | 1.0 | 86 | 1.0 | 49 |
| 11169581 Calabazas Creek at Mt. Eden Road, near Saratoga | | 34 | .8 | 43 | 1.0 | 77 | .9 | 56 |
| 11169586 Calabazas Creek tributary No. 3 at Mt. Eden Road, near Saratoga | | 43 | 1.0 | 54 | 1.3 | 97 | 1.1 | 56 |
| 11169588 Calabazas Creek tributary No. 4 at Mt. Eden Road, near Saratoga | | 161 | 3.7 | 212 | 5.0 | 373 | 4.3 | 57 |
| 11169600 Prospect Creek at Saratoga Golf Course, near Saratoga | | 21 | .5 | 19 | .5 | 40 | .5 | 46 |
| 11169616 Calabazas Creek at Rainbow Drive, near Cupertino | | 49 | 1.1 | 22 | .5 | 71 | .8 | 31 |

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[1] Ratio of sediment yield at indicated station to that of Calabazas Creek tributary at Mt. Eden Road, near Saratoga (11169580).

During small storms:

1. Total sediment yield is extremely variable from station to station. This is probably due to a nonuniformity of rainfall intensity and magnitude throughout the basin.
2. Total sediment yield at the index station (Calabazas Creek tributary at Mt. Eden Road) is less than the yield of the Calabazas Creek basin above Rainbow Drive.
3. Total sediment yield at Calabazas Creek tributary No. 4 (11169588) is generally many times larger than that for any other station in the basin. Fine-sediment yield ranges from 0.6 to 64 times larger than the index station. Coarse-sediment yield ranges from 2.9 to 3,600 times larger than the index station. The Calabazas Creek tributary No. 4 station is downstream from a large gravel pit, which is adjacent to the stream, and near a vineyard.
4. Total sediment yield from Prospect Creek at Saratoga Golf Course (11169600) is consistently lower than that of the index station. Prospect Creek is underlain entirely by the Santa Clara Formation, which allows larger infiltration of rainfall into the soil and less runoff than the Franciscan Formation.

During large storms:

1. Total sediment yields are relatively uniform at most stations because rainfall is more uniform throughout the basin during large storms.
2. Coarse sediment constitutes a large percentage of the total sediment yield because stream velocities are sufficiently large to transport most of the coarse particles found in the streambed.
3. The percentage of coarse sediment transported during large storms is about the same as the percentage of coarse sediment transported annually at primary stations.
4. Total sediment yield at Calabazas Creek tributary No. 4 (11169588) is four to nine times larger than that for other stations in the basin. Considering sediment transported during large and small storms (see item 4 for small storms), the annual total sediment yield of Calabazas Creek tributary No. 4 would, by rough estimate, be about 10 times that of the index station.
5. Total sediment yield at Prospect Creek tributary near Saratoga (11169611), which drains a single-family residential area, is very small. During the one large storm that was monitored, the yield was about 1 percent of that for the index station.

## Sediment Trapped in Comer Drive Debris Basin

A significant part of the sediment eroded from the area upstream from the Calabazas Creek at Rainbow Drive station (11169616) is trapped in a debris basin at Comer Drive (fig. 1). The volume of sediment trapped in the debris basin during the 1974 and 1975 storm seasons was determined by annual surveys. Additional surveys were made after sediment was removed by personnel of the Santa Clara Valley Water District.

Surveys of the debris basin (table 5) indicate that 1,750 and 2,790 $m^3$ of sediment were trapped during the 1974 and 1975 storm seasons. After each storm season a volume of sediment approximately equal to that trapped was removed to restore the capacity of the debris basin.

Samples of deposited sediment were obtained during each survey and analyzed for average specific weight and particle-size distribution. These analyses were used to convert sediment volume to weight units for a comparison of the amount of sediment trapped in the debris basin with concurrent total sediment-discharge data for primary sediment stations.

The relative quantity of particles of various sizes deposited during each storm season suggests that the trap efficiency of the debris basin is variable and depends on the total quantity of sediment contributed to the basin. An increase in coarse sediment and a decrease in fine sediment during 1975 indicates sorting of particles within the debris basin. Stormflows passing through the basin, after it is filled, pick up fine sediment which was previously deposited and transport the fine sediment downstream. This sorting process results in a coarser mix of sediment particles at the end of large storm seasons. The storage capacity of the debris basin differs each year, depending upon maintenance precedures, but is small relative to the annual sediment inflow. The basin was filled to near capacity at the end of the 1975 storm season, with about 150 $m^3$ storage below spillway elevation. Aggradation of the streambed relative to the dam is shown in figure 8.

TABLE 5.--*Summary of sediment deposition and removal at Comer Drive debris basin*

[Sediment data in parentheses indicate quantity of deposited sediment per square kilometer of drainage area]

| Storm season | Drainage area ($km^2$) | Sediment deposited | | | | | Specific weight ($g/m^3$) | Sediment removed |
|---|---|---|---|---|---|---|---|---|
| | | Cubic meters | Tonnes | | | | | |
| | | | Silt-clay | Sand | Gravel | Total | | Cubic meters |
| 1974 | 6.32 | 1,750 | 300 | 1,420<br>(225) | 1,050<br>(166) | 2,770 | $1.58 \times 10^6$ | 1,740 |
| 1975 | 6.32 | 2,790 | 30 | 1,840<br>(291) | 3,090<br>(489) | 4,960 | $1.78 \times 10^6$ | 2,490 |

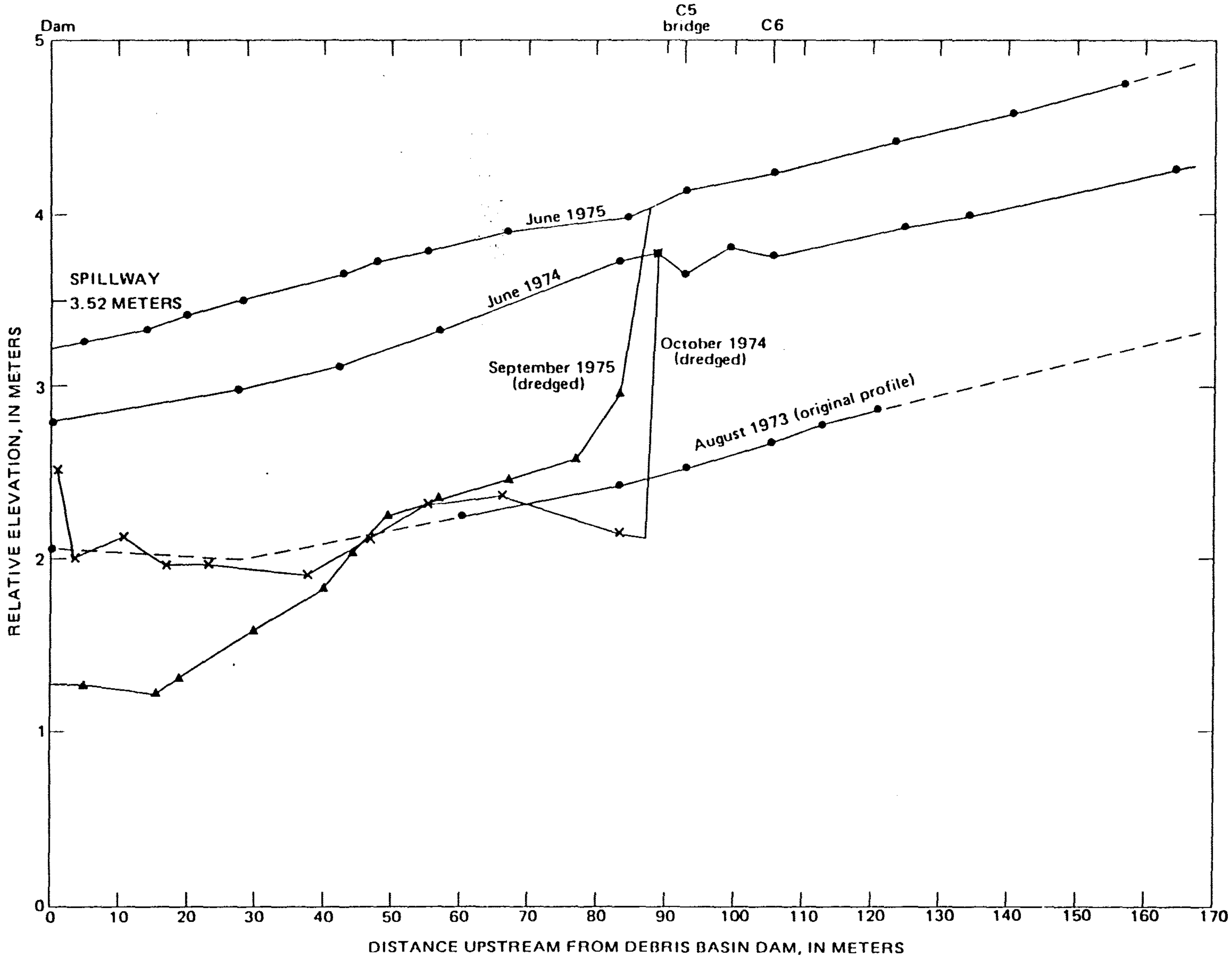


FIGURE 8.--Longitudinal thalweg profile of debris basin at Comer Drive.

Sediment inflow to the debris basin is eroded from a 6.32-$km^2$ area including a primary sediment station (Calabazas Creek tributary at Mt. Eden Road, 11169580) and three secondary stations (Calabazas Creek, 11169581; Calabazas Creek tributary No. 3, 11169586; and Calabazas Creek tributary No. 4, 11169588). A comparison of coarse sediment deposited in the debris basin (391 t/$km^2$, 1974; 780 t/$km^2$, 1975) with total sediment yield for the primary station (208 t/$km^2$, 1974; 323 t/$km^2$, 1975) indicates that the intervening drainage area contributes about twice as much coarse sediment per square kilometer as the area upstream from the primary station.

Sediment-yield ratios in table 4 suggest that much of the sediment in the drainage area between the primary station and the debris basin is contributed from Calabazas Creek tributary No. 4 (11169588). If the coarse-sediment yield from the intervening drainage area is assumed to be similar to that of the primary station, the coarse-sediment yield of Calabazas Creek tributary No. 4 would have been eight times that of the upstream drainage in 1974 and 13 times greater in 1975. At least 50 percent of the sediment trapped in the debris basin annually probably originates from Calabazas Creek tributary No. 4.

The quantity of sediment trapped in the debris basin is a significant part of that transported in the Calabazas Creek basin. If this sediment were not intercepted, the quantity of sediment passing the Rainbow Drive station would probably have been about 30 percent larger in 1974 and 1975. Additionally, the sediment trapped by the debris basin is virtually all coarse material, which would be expected to deposit in the lower reaches of Calabazas Creek where stream gradients are small.

## WATER QUALITY

Water samples were analyzed during the study period for various constituents to determine a baseline of water-quality characteristics and to determine if the trace elements and pesticides detected in streambed sediment in calendar year 1972 (U.S. Geological Survey, 1973b) were transported by the streams. Three water samples per year (1974 and 1975) were collected at Calabazas Creek tributary at Mt. Eden Road (11169580), Prospect Creek at Saratoga Golf Course (11169600), and Calabazas Creek at Rainbow Drive (11169616). Analyses of the samples indicate that the water at Prospect and Calabazas Creeks can be classified as magnesium-calcium bicarbonate. The water from the Calabazas Creek tributary is best classified as mixed-cation bicarbonate. Figure 9 shows the Stiff diagrams for the three stations. These diagrams show that water type remains the same at low and high flow, but ion concentrations are greater at low flow.

The water at all stations varies from moderately hard at medium to high flows to very hard at low flows. Nutrient concentrations (nitrogen and phosphorus) are not high if compared with other streams in the San Francisco Bay area. The nutrient concentrations are higher during high flows. A similar relation was observed at Castro Valley Creek, Calif. (Sylvester and Brown, 1978). Nutrient concentrations for the three stations sampled were within these ranges: total nitrogen, 0.66 to 10 mg/L (milligrams per liter), and total phosphorus, 0.04 to 3.5 mg/L.

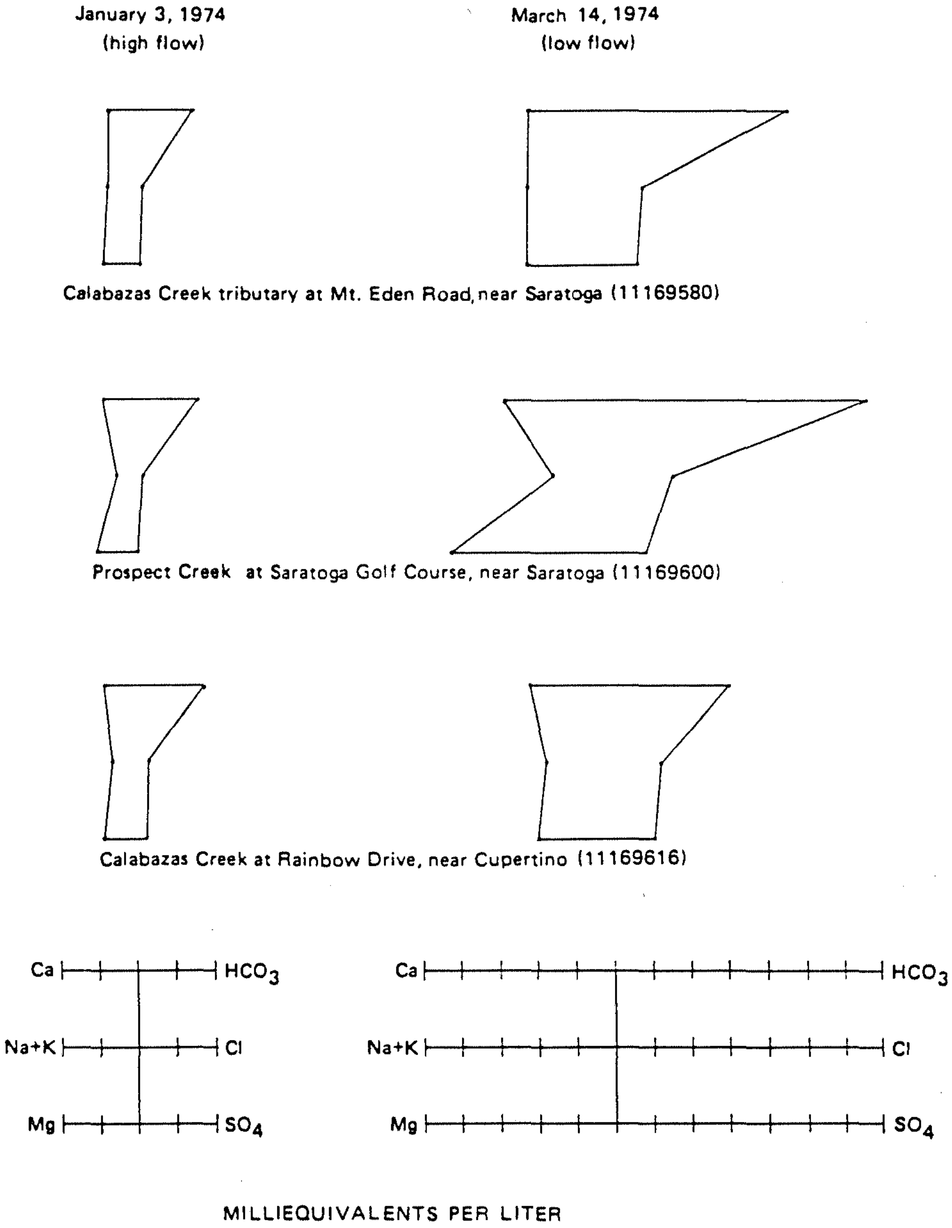


FIGURE 9.--Major-ion characteristics at the primary stations.

Three trace elements--chromium, mercury, and lead--were detected in significant concentrations only during high flows, when the streams were turbid. Significant concentrations for this study are defined as those that exceed the limits for public water supplies recommended by the U.S. Environmental Protection Agency (1973). The relation of significant concentrations of trace elements to high flow suggests that these elements are probably adsorbed or transported on sediment particles. Arsenic and cadmium were not detected in significant concentrations.

Pesticides were absent or found in insignificant concentrations in water samples collected from Calabazas Creek tributary at Mt. Eden Road (11169580) and Prospect Creek at Saratoga Golf Course (11169600). However, DDT, DDE, diazinon, 2,4-D, and silvex were detected in significant concentrations at Calabazas Creek at Rainbow Drive (11169616) during high flows. Pesticides, like trace elements, are probably closely associated with the sediment particles.

Six water samples, two at each of the three primary stations, were analyzed for fecal-coliform and fecal-streptococcal bacteria during 1974 and 1975. Results showed low to moderate concentrations of bacteria--a range of 50-100 col/100 mL (colonies per 100 milliliters of water) for fecal-coliform and 43-880 col/100 mL for fecal streptococci. The Environmental Protection Agency (EPA) has not established acceptable limits for fecal-coliform or fecal-streptococcal bacteria in recreational water. They have suggested that if an arbitary limiting value for fecal-coliform bacteria is desired for bathing and swimming water, then a geometric mean of a series of samples should not exceed 1,000 col/100 mL (U.S. Environmental Protection Agency, 1973, p. 32). No suggested standards for fecal-streptococcal bacteria are given by the EPA.

In summary, water-quality conditions during low-flow periods have been well-defined by the chemical and bacteriological analyses to date. The high-flow samples indicate that significant amounts of various trace elements and pesticides adsorbed on sediment can be transported by streams in the basin. The few samples analyzed, however, are insufficient to make an estimate of sources or of quantities transported. Intensive sampling throughout several storms would be needed to define concentrations of constituents during storms.

## CHANGES IN STREAM-CHANNEL GEOMETRY

Stream channels are influenced by climatic factors and the physical characteristics of the basin. If an external impact is imposed on the basin that significantly changes the character of the basin, the shape and dimensions of stream channels may undergo large changes.

Repetitive surveys of stream-channel geometry were made at 14 sites in the basin (fig. 1) to document normal changes resulting from climatic events and unusual changes that may be related to present urban development. These sites were established in the summer 1973 in rural and urban areas. Permanent reference points were established on each bank of the channel for use in future surveys.

To facilitate a comparison of large changes in channel geometry, an arbitrary elevation was selected to represent the upper limit of the channel at a given site (fig. 10). This elevation was generally located about half a meter above estimated flood stage at sites where all probable flows would be confined to the channel.

Initial dimensions and thalweg characteristics of the stream channels and net changes between storm seasons are summarized in table 6. Annual changes in channel dimensions (depth and width) were small at most of the sites.

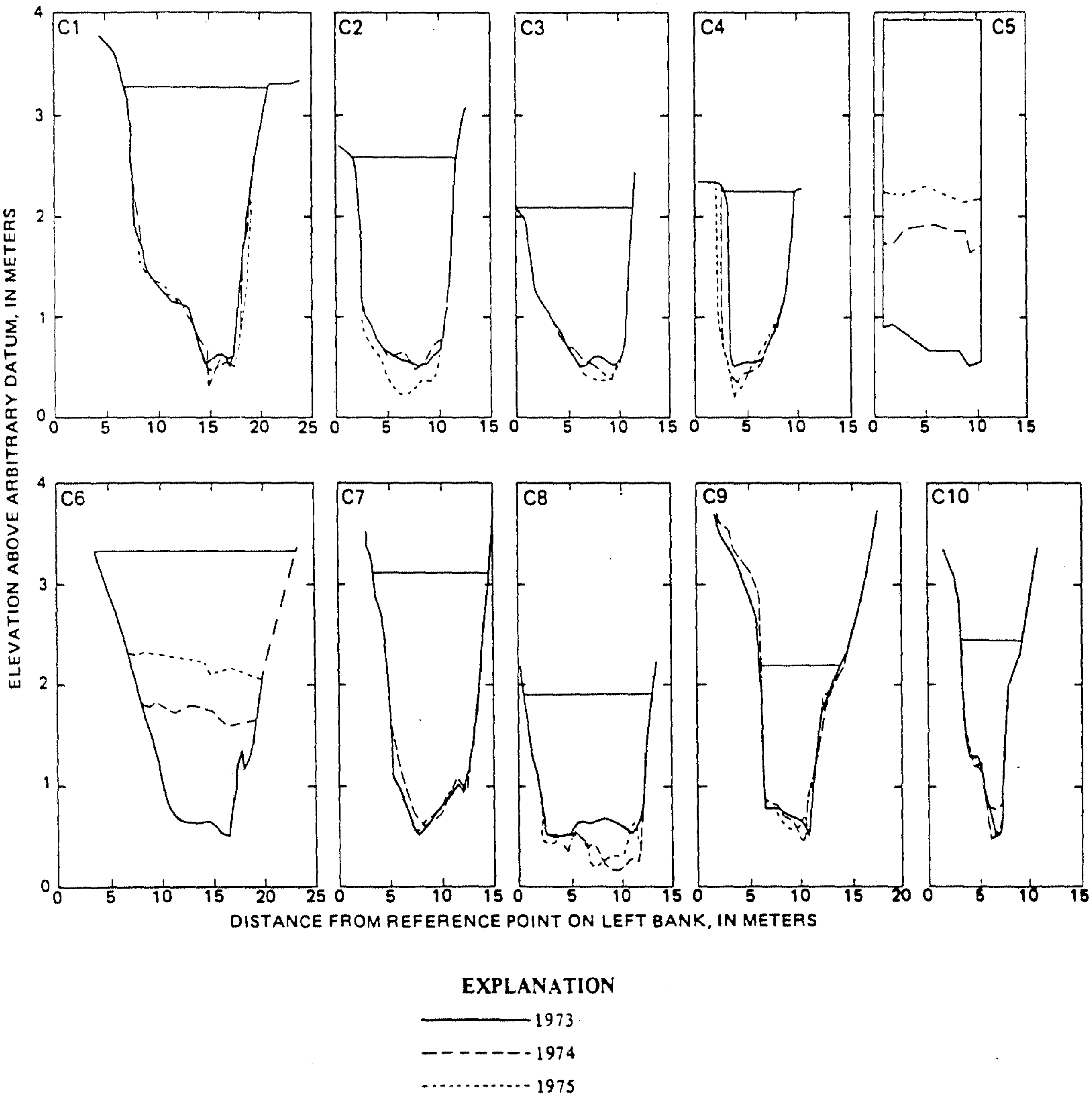


FIGURE 10.--Changes in stream channel at channel-geometry survey sites, 1973-75.

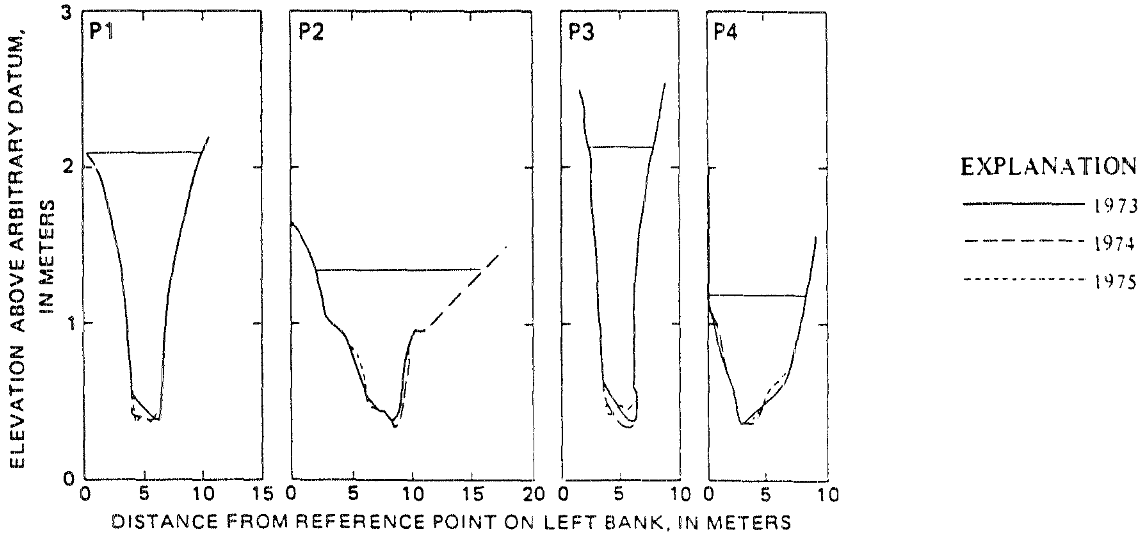


FIGURE 10.--Changes in stream channel at channel-geometry survey sites, 1973-75--Continued.

Changes in average depth were generally less than 0.1 m, and an increase in depth for one year was often compensated for by a decrease in depth for the other year. There were no appreciable differences in depth changes in urban areas relative to rural areas. Large decreases in depth were observed at sites C5 and C6 between both storm seasons. These decreases are due to sediment deposited upstream from the debris dam.

A significant change in width was observed only at site C4. This increase in width was caused by dredging of the channel between the 1973 and 1974 surveys, according to a nearby resident. Continued widening between 1974 and 1975 may be due to channel adjustment to subsequent dredging.

Changes in the thalweg (lowest point in the streambed) are often indicative of the stability of the streambed. The thalweg generally moves back and forth across the streambed, defining the most active part of the channel. Over a long period of time, a raising or lowering of the thalweg elevation may indicate an increase or decrease in the transport rate of coarse sediment.

Changes in thalweg elevation (table 6) follow trends similar to those for average depth, indicating that channel changes at all survey sites are mostly confined to the streambed and that the banks of the channels are stable. Although no conclusive trends can be drawn from the survey data obtained thus far, a slight lowering of the streambed may be occurring at sites C1, C2, C3, and C4. This result would be expected downstream from the debris basin at Comer Drive as coarse sediment is trapped and removed from the stream.

TABLE 6.--*Initial dimensions and annual*

[Location of survey

| Survey site | Upstream drainage area (km$^2$) | Average depth (m) | | | Width (m) | | | Cross-sectional area (m$^2$) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial | Change | | Initial | Change | | Initial | Change | |
| | | 1973 | 1973-74 | 1974-75 | 1973 | 1973-74 | 1974-75 | 1973 | 1974-74 | 1974-75 |
| C 1 | 10.3 | 1.82 | +0.03 | +0.06 | 14.0 | 0.0 | 0.0 | 25.5 | +0.4 | +0.8 |
| C 2 | 10.2 | 1.67 | -.02 | +.18 | 10.1 | .0 | .0 | 16.8 | -.1 | +1.8 |
| C 3 | 10.1 | 1.17 | .00 | +.04 | 11.3 | .0 | .0 | 13.2 | .0 | +.5 |
| C 4 | 7.15 | 1.35 | +.08 | -.01 | 7.0 | +.4 | +.3 | 9.5 | +1.1 | +.3 |
| C 5 | 6.35 | 3.20 | -1.10 | -.37 | 9.5 | .0 | .0 | 30.4 | -10.5 | -3.5 |
| C 6 | 6.35 | 1.66 | -.44 | -.30 | 19.9 | .0 | .0 | >33.0 | -8.7 | -6.0 |
| C 7 | 5.41 | 1.80 | -.05 | +.02 | 11.3 | .0 | .0 | >20.3 | -.5 | +.2 |
| C 8 | 3.50 | 1.14 | +.17 | -.03 | 12.8 | .0 | .0 | >14.6 | +2.2 | -.4 |
| C 9 | 2.36 | 1.09 | -.02 | -.02 | 7.9 | .0 | .0 | > 8.6 | -.1 | -.2 |
| C10 | 1.06 | 1.09 | .00 | -.06 | 6.1 | .0 | .0 | > 6.6 | .0 | -.3 |
| P 1 | 2.51 | 1.11 | -.04 | +.01 | 10.0 | .0 | .0 | 11.1 | -.4 | +.1 |
| P 2 | 1.99 | .58 | +.01 | -.01 | 14.6 | .0 | .0 | > 8.5 | +.1 | -.1 |
| P 3 | 1.92 | 1.50 | +.02 | -.03 | 5.5 | .0 | .0 | > 8.2 | +.2 | -.2 |
| P 4 | .70 | .67 | +.02 | -.02 | 8.6 | .0 | .0 | > 5.8 | +.1 | -.1 |

## HYDROLOGIC SIMULATION

Hydrologic simulation is a potentially important tool for estimating the magnitude and future frequency of floods, water-quality loading of streams, and the effects of urbanization on the hydrology of an area. In recent years, increased availability of computers has led to the development of numerous mathematical models that are capable of simulating hydrologic processes quickly and economically.

During this study, a parametric rainfall-runoff model, developed by D. R. Dawdy, was used to simulate discharge hydrographs at secondary stations where sediment samples were taken. The probable accuracy of simulation of the model was tested by comparing simulated water discharges at primary stations with observed data.

*changes in stream-channel geometry, 1973-75*

sites shown in figure 5]

| Survey site | Thalweg elevation, arbitrary datum (m) | | | Thalweg slope (m/m) | | | Upstream development |
|---|---|---|---|---|---|---|---|
| | Initial | Change | | Inital | Change | | |
| | 1973 | 1973-74 | 1974-75 | 1973 | 1973-74 | 1974-75 | |
| C 1 | 0.5 | -0.06 | +0.13 | 0.0086 | +0.0010 | -0.0007 | Urban, low-flow diversion, debris dam |
| C 2 | .5 | -.02 | -.22 | .0113 | +.0001 | +.0001 | Urban, low-flow diversion, debris dam |
| C 3 | .5 | -.13 | -.01 | .0098 | -.0001 | +.0048 | Urban, low-flow diversion, debris dam |
| C 4 | .5 | -.15 | -.18 | .0084 | +.0023 | +.0010 | Urban, channel dredged in 1973, debris dam |
| C 5 | .5 | +1.13 | +.50 | .0101 | -.0009 | +.0006 | Rural, 92 m upstream from debris dam |
| C 6 | .5 | +1.05 | +.51 | .0101 | -.0009 | +.0006 | Rural, 105 m upstream from debris dam |
| C 7 | .5 | +.08 | -.03 | .0158 | +.0005 | -.0073 | Rural, gravel pit |
| C 8 | .5 | -.34 | +.03 | .0142 | +.0035 | +.0001 | Rural, gravel pit |
| C 9 | .5 | -.04 | +.11 | .0187 | -.0052 | +.0061 | Rural |
| C10 | .5 | -.02 | +.27 | .0256 | +.0016 | -.0015 | Rural |
| P 1 | .5 | +.05 | -.04 | .0125 | -.0007 | +.0008 | Rural subdivision, golf course |
| P 2 | .5 | -.03 | +.07 | .0414 | -.0044 | +.0180 | Rural subdivision, golf course |
| P 3 | .5 | -.07 | +.12 | .0174 | +.0018 | -.0012 | Rural, golf course |
| P 4 | .5 | +.01 | -.00 | .0149 | +.0020 | -.0049 | Rural |

## Description of Rainfall-Runoff Model

The basic model is divided into three principal components taken from other models. The antecedent-moisture accounting and infiltration components are similar to those described by Dawdy, Lichty, and Bergmann (1972). The routing component was developed by Schaake (1971) and is based on the theoretical motion of kinematic waves in uniform channels. The resulting model attempts to simulate events by approximating physical laws which apply to the hydrologic cycle and includes various parameters and input data which are representative of the physical characteristics of the basin. Model inputs and parameters were in English units. Results were converted to metric units for ease of comparison with previous sections of this report.

The antecedent-moisture accounting component contains four parameters which are used to simulate moisture redistribution in the soil column and evapotranspiration from the soil:

EVC is a pan coefficient for converting measured pan evaporation data at a given site to potential evapotranspiration in the basin.

RR represents the proportion of daily rainfall that infiltrates into the soil during periods that are not simulated by the model. This parameter enables the model to continue soil moisture accounting during periods when rainfall is too small for simulation or during periods when hydrologic data are missing or doubtful.

BMSM is the maximum amount of base moisture storage (inches) at field capacity or when the soil is near saturation.

DRN is a constant drainage rate for redistributing soil moisture at the end of a simulated storm event, in inches per hour.

Input data required for this component include daily rainfall, daily pan evaporation, and the initial condition of the soil column. The model assumes that this initial condition is at the wilting point, or the moisture content of the soil which is insufficient for plant growth.

Output from this component consists of the moisture content of the soil prior to a storm (BMS) and the volume of moisture which infiltrates into the soil during a storm (SMS). Output from the antecendent-moisture component (BMS and SMS) and unit rainfall data are provided as input to the infiltration component of the model.

The infiltration component contains three parameters which are used to determine infiltration rates and rainfall excess during a storm:

SWF is the suction at the wetted front for soil moisture at field capacity, in inches of pressure.

KSAT is the minimum value of hydraulic conductivity used to determine infiltration rates (minimum infiltration rate, in inches per hour).

RGF is the ratio of suction at the wetted front for soil moisture at wilting point to that at field capacity.

The model simulates infiltration into the soil using the Philips concept (Dawdy, Lichty, and Bergman, 1972) of a two-part soil-moisture distribution. Prior to a storm the soil column contains an amount of soil moisture stored at a uniform soil moisture content which can vary from wilting point to field capacity. During the storm, moisture is added to the soil column. The wetted front moves from the soil surface downward. At the end of the storm the wetted front moves back toward the soil surface. Moisture accumulated during the storm is redistributed to base moisture storage and is dissipated by evapotranspiration. This process continues until the next storm.

The routing component distributes the rainfall excess derived from the infiltration component through a series of overland flow and channel segments in the basin. All required parameters and input data are expressed as functions of time or are related to the physical characteristics of the basin. The routing component contains three parameters:

FRN is a roughness parameter similar to the Manning *n*.

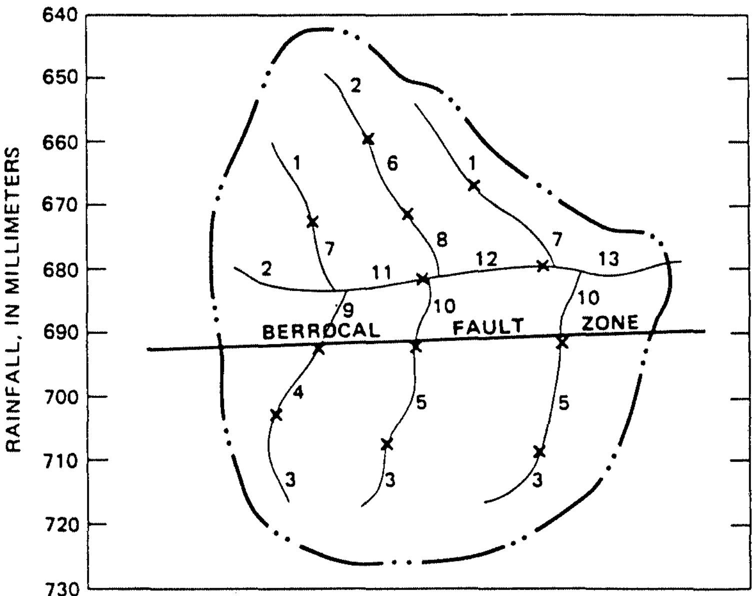
PARAM (1) is a parameter generally representative of a dimension of a given type of segment, such as width for overland flow and channel segments, or diameter for a pipe segment.

PARAM (2) is a parameter representative of depth in the special case of a rectangular channel or the proportion of impervious area for an overland flow segment. Other types of channels (triangular or pipe) are defined completely by PARAM (1).

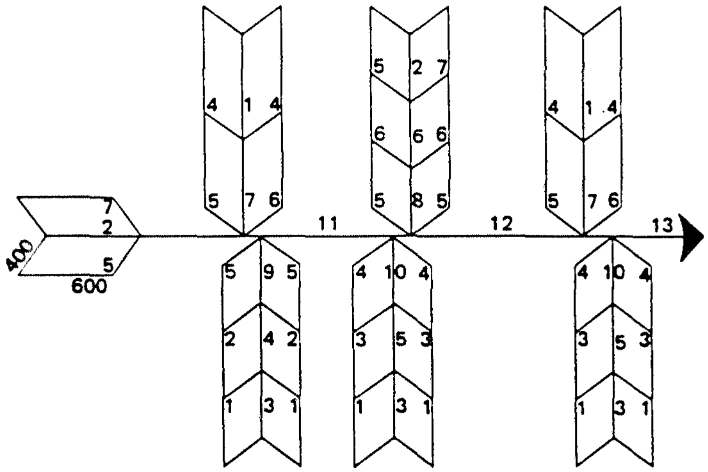
Input data required for the routing component include physical characteristics of the basin obtained from a contour map (segment length and slope), Thiessen coefficients obtained from an annual isohyetal map of the area, and optional items which control the desired accuracy or detail of the routing (number of segments, identity of segment, subdivision of channel length, time intervals). Output data consist of water discharge hydrographs. These hydrographs can be determined at the downstream end of any segment in the basin.

The division of a given basin into individual segments is illustrated in figure 11, which is the model's conception of the basin upstream from the gaging station Calabazas Creek tributary at Mt. Eden Road (11169580). The upper part of figure 11 shows a sketch of the drainage boundaries, variation of annual rainfall, and an arbitrary division of the stream channel network of the basin into various channels. If two or more channels have similar length, slope, roughness, rainfall, imperviousness, and upstream tributaries, the channels can be given the same numerical designation. The combining of similar channels and overland flow segments is advantageous because less computer time is needed for the simulation.

The lower part of figure 11 shows the division of the basin into overland flow and channel segments as conceptualized by the model. Overland-flow segments with similar physical characteristics can also be given the same number. Thus it is possible for this basin to model 54 actual physical segments by the use of only 20 different model segments (7 overland-flow segments and 13 channel segments).



STREAM CHANNEL NETWORK OF BASIN



DIVISION OF BASIN INTO STREAM-CHANNEL AND OVERLAND-FLOW SEGMENTS

FIGURE 11.--Stream-channel network and division of the basin into stream-channel and overland-flow segments.

## Preliminary Simulation Results

Simulation runs with the rainfall-runoff model were made for two subbasins--Prospect Creek at Saratoga Golf Course (11169600) and Calabazas Creek tributary above Mt. Eden Road (11169580). The 1973 storm season (October 1972 through March 1973) was arbitrarily chosen as the calibration period for the model. This period was chosen because hydrologic data had been obtained for a large number of storms and because a debris basin had been constructed during the following summer which could significantly affect later stormflows in the Calabazas Creek basin.

Hydrologic data used in the calibration of the model include:

1. Daily and unit rainfall (compiled for 15-minute time increments) at Garrod Ranch (11169575).
2. Daily pan evaporation at Alamitos percolation pond, San Jose (about 17 km east of study basin).
3. Daily and unit water discharge (15-minute) at Prospect Creek at Saratoga Golf Course, near Saratoga (11169600).
4. Daily and unit water discharge (15-minute) at Calabazas Creek tributary at Mt. Eden Road (11169580).
5. Mean annual isohyetal map for Cupertino 7 1/2-minute quadrangle (Santa Clara Valley Water District, written commun., 1973).
6. Data related to the physical characteristics of the basin (segment length, slope, and channel dimensions), estimated from contours on the Cupertino 7 1/2-minute quadrangle map.
7. Initial parameter values, obtained from suggested values given in the documentation of the model (D. R. Dawdy, written commun., 1976), or, in the case of EVC, RR, and DRN, estimated or computed from rainfall and water discharge records. Initial parameter values are given in table 7.

Optimization runs were made to determine a combination of parameters SWF, KSAT, RFG, and BMSM which best fit the storm runoff of storms selected for calibrating the model. Optimization was based on an objective function equal to the sum of the squared deviations of the logarithms of storm volumes (Dawdy, Lichty, and Bergman, 1972). After several optimization runs were made, individual storms were analyzed to determine if the observed runoff at gaging stations was related to observed rainfall. Several storms in the early part of the storm season (October and November) were rejected for simulation because insignificant runoff was observed or runoff was low relative to most of the other storms. Of the 14 storms selected for simulation, 3 were not used in optimization of storm volume, but data were retained for possible further analysis. The storms not used include the large storm of November 13-16, 1972, and the two small storms of January 29-30, 1973, and March 6, 1973.

TABLE 7.--*Initial and optimum parameters used to fit hydrologic data for Calabazas Creek tributary at Mt. Eden Road, near Saratoga, and Prospect Creek at Saratoga Golf Course, near Saratoga*

| Parameter | Calabazas Creek tributary at Mt. Eden Road, near Saratoga (11169580) | | Prospect Creek at Saratoga Golf Course, near Saratoga (11169600) | |
|---|---|---|---|---|
| | Initial | Optimum | Initial | Optimum |
| SWF | 5.0 | 3.4 | 5.0 | 5.9 |
| KSAT | .1 | .029 | .1 | .045 |
| RGF | 10 | 6.7 | 10 | 10.9 |
| BMSM | 3.0 | 3.2 | 3.0 | 3.5 |
| EVC | .7 | .7 | .7 | .7 |
| RR | .41 | .41 | .82 | .82 |
| DRN | .5 | .5 | .5 | .5 |

After storm volumes had been optimized to determine the lowest value of the objective function, peak flows were computed. Initial values of simulated peak flow were close to those obtained from flow records. Only minor adjustments in overland flow and channel roughness were needed to obtain adequate agreement between observed and simulated peak flows. Other data pertaining to the physical characteristics of the individual basins were not altered.

A comparison of observed runoff and peak flow data thus far analyzed is shown in table 8. Actual and simulated hydrographs for the two stations modeled are shown in figure 12. These data, although preliminary, indicate that simulated storm runoff and peak flow values are in reasonable agreement with observed values for the larger storms. Small storms show poor agreement.

## TABLE 8.--*Comparison of simulated and observed rainfall and runoff data*

| Storm date | Observed rainfall at Garrod Ranch (mm) | Calabazas Creek tributary at Mt. Eden Road, near Saratoga (11169580) | | | | | | Prospect Creek at Saratoga Golf Course, near Saratoga (11169600) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Runoff volume (mm) | | Percent deviation | Peak flow ($m^3/s$) | | Percent deviation | Runoff volume (mm) | | Percent deviation | Peak flow ($m^3/s$) | | Percent deviation |
| | | Observed | Simulated | | Observed | Simulated | | Observed | Simulated | | Observed | Simulated | |
| 1972 | | | | | | | | | | | | | |
| November 13-16 | 115 | 53.1 | 55.6 | +5 | 1.42 | 1.28 | -10 | 13.8 | 26.6 | +93 | 0.51 | 0.60 | +18 |
| 1973 | | | | | | | | | | | | | |
| January 8-10 | 70.9 | 33.8 | 26.9 | -20 | 1.16 | .91 | -22 | 13.8 | 10.9 | -21 | .19 | .28 | +47 |
| January 15-16 | 69.3 | 48.5 | 42.7 | -12 | 2.58 | 2.20 | -15 | 24.6 | 21.6 | -12 | 1.10 | .83 | -25 |
| January 16-18 | 87.9 | 75.4 | 69.6 | -8 | 1.76 | 1.23 | -30 | 40.3 | 53.3 | +32 | .96 | .67 | -30 |
| January 29-30 | 24.6 | 3.7 | 5.0 | +35 | .051 | .055 | +8 | 3.8 | 1.4 | -63 | .057 | .007 | -88 |
| February 3- 5 | 49.5 | 15.6 | 21.1 | +35 | .25 | .35 | +40 | 13.3 | 8.3 | -38 | .093 | .092 | -1 |
| February 5- 7 | 61.7 | 48.8 | 46.7 | -4 | 1.13 | 1.23 | +9 | 26.8 | 31.3 | +17 | .48 | .65 | +35 |
| February 9-12 | 65.5 | 66.8 | 57.7 | -14 | 1.59 | 1.16 | -27 | 45.7 | 33.8 | -26 | .76 | .48 | -37 |
| February 12-13 | 24.9 | 18.1 | 19.2 | +6 | .42 | .48 | +14 | 14.6 | 14.1 | -3 | .21 | .19 | -10 |
| February 24 | 27.2 | 8.4 | 9.2 | +10 | .65 | .27 | -58 | 3.8 | 4.0 | +5 | .068 | .043 | -37 |
| February 26-27 | 41.9 | 21.3 | 23.1 | +8 | 1.36 | .88 | -35 | 10.7 | 12.1 | +13 | .42 | .31 | -26 |
| February 27-28 | 51.6 | 70.9 | 45.0 | -37 | 2.46 | 1.01 | -59 | 24.1 | 29.2 | +21 | .62 | .46 | -26 |
| March 6 | 12.4 | 6.5 | 3.4 | -48 | .51 | .047 | -91 | 1.9 | 1.3 | -31 | .040 | .010 | -75 |
| March 19-20 | 31.0 | 10.5 | 13.2 | +26 | .51 | .54 | +6 | 5.0 | 5.3 | +6 | .068 | .094 | +38 |

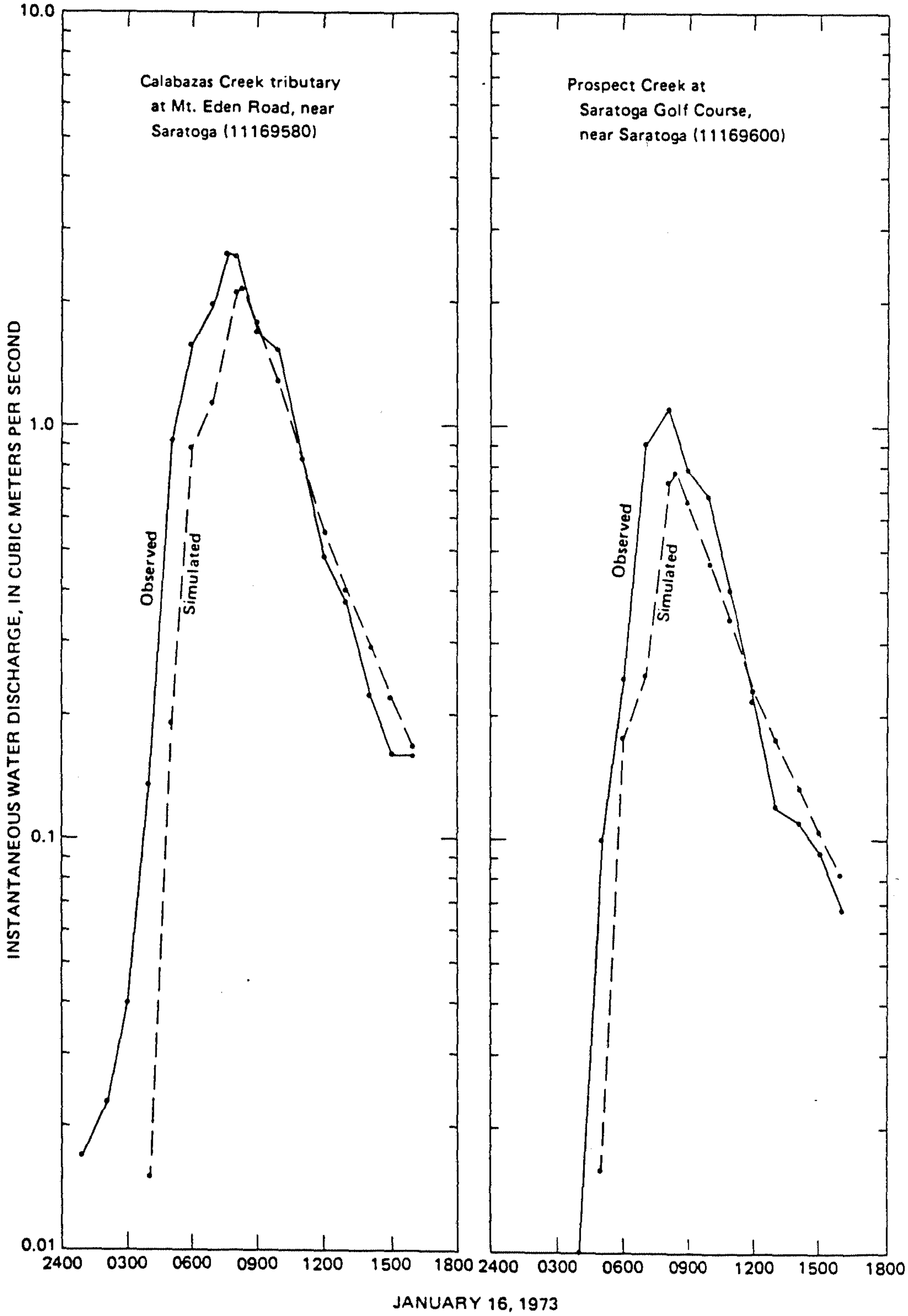


FIGURE 12.--Typical comparison of simulated and observed streamflow at Calabazas Creek tributary at Mt. Eden Road, near Saratoga, and Prospect Creek at Saratoga Golf Course, near Saratoga.

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PRELIMINARY
SUBJECT TO REVISION

# ENVIRONMENTAL IMPACT REPORT
relative to
Flood Control Improvements
on
Calabazas Creek Debris Basin
at Comer Drive
North Central Zone
Project No. 20010

BOX NO. 0875

Santa Clara County Flood Control
and
Water District
August 1972

PRELIMINARY
SUBJECT TO REVISION

# SANTA CLARA COUNTY FLOOD CONTROL AND WATER DISTRICT

# ENVIRONMENTAL IMPACT REPORT

relative to

Flood Control Improvements

on

Calabazas Creek Debris Basin

at Comer Drive

North Central Zone

Project No. 20010

August 1972

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# ENVIRONMENTAL IMPACT REPORT
# for the
# Calabazas Creek Debris Basin
# Flood Control Improvement Project

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# INTRODUCTION AND PROJECT DESCRIPTION

California Public Resources Code Section 21151 requires a report "on any project...which may have a significant effect on the environment...". The following report is therefore not the result of a decision that the proposed construction of a debris basin on Calabazas Creek will in fact have such an effect. It was prepared by the Santa Clara County Flood Control and Water District staff after consultation with appropriate agencies of County and State Government. The District is, however, solely responsible for its contents.

Calabazas Creek has its headwaters on the easterly slopes of the Santa Cruz Mountains from which it flows in a northeasterly direction to outfall into Guadalupe Slough just north of Mountain View-Alviso Road. It drains about 21 square miles of mountain and valley floor land. The location of the proposed project is in the upper portion of the creek, in the City of Saratoga, where the drainage area is 2.5 square miles. This area has an annual average rainfall of about 35 inches and the anticipated flood flow at the project site is about 1,100 cubic feet per second.

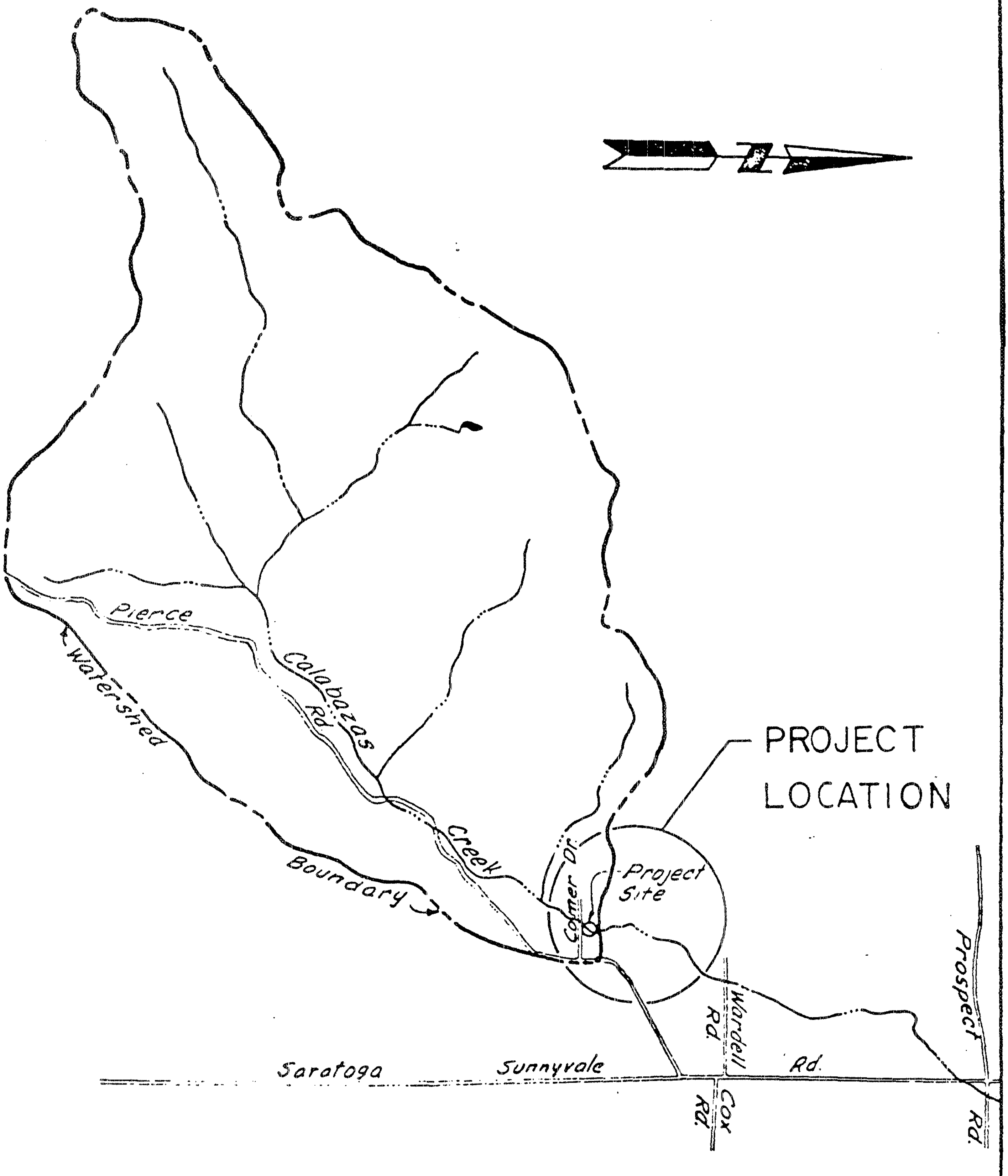
Historically, silt and debris from the wooded areas upstream from Comer Drive have been carried down the creek during flood periods. When the flood waters recede, the materials carried in the water are deposited along the stream bed at bends, bridges, box culverts and other reaches of the stream where the bottom slope flattens. Many of the deposition areas are not easily accessible. The silt and debris deposited in the creek reduces the flood water carrying capacity of the stream and increases the over-bank flooding hazard. The District has been requested by the Cities of Saratoga and San Jose to alleviate this hazard.

It is proposed to meet the need described above by construction of a project on Calabazas Creek in the vicinity of Comer Drive, about 1,800 feet upstream of Wardell Road, in the City of Saratoga (see Plate 1). The project commences at the Comer Drive Bridge and terminates about 410 feet northerly (downstream) of the Comer Drive Bridge.

The proposed improvement consists of a 42' wide by 5' high reinforced concrete dam, with an energy dissipator on the downstream side. The dam will create a basin to collect silt and debris. The basin will be approximately 270 feet long by 130 feet wide. Construction within the basin will consist of removing gravel and debris and trimming the bottom of an already widened portion of the creek that has eroded during past flows. The energy dissipator consists of a sloping chute on the downstream side of the dam with concrete blocks spaced over the surface of the chute. Rock lining will be placed on the bottom and sides of the creek downstream of the energy dissipator. There will be one access ramp into the basin from Comer Drive on the west side of the creek and another ramp just downstream from the dam on the west side.

The purpose of the project is to reduce the flood hazard in the downstream reaches of the creek by providing a central debris and silt collection site where debris and silt can be removed on a regular basis.

The basin will hold about 2 acre-feet of silt and debris and still pass the design flood of 1,100 cubic feet per second.



# CALABAZAS CREEK DEBRIS BASIN

Project No. 22310
Watershed Area = 2.5 Sq. Miles
Scale: 1" = 2000'

Plate I

# ENVIRONMENTAL IMPACT STATEMENT

Calabazas Creek is located in the westerly portion of the Santa Clara Valley and has its head waters on the easterly slopes of the Santa Cruz Mountains, westerly of the City of Saratoga. The stream flows in a general northerly direction to outfall into Guadalupe Slough just north of Mountain View-Alviso Road. The proposed improvement is located in the upstream portion of the existing creek in a suburb area of the City of Saratoga. The total area of the watershed above the proposed project is 2.5 square miles, most of which is hill land.

The hill lands are characteristically brushy woodlands with the predominant trees being oaks (white and live), buckeyes and bay. The gently sloping valley floor of the watershed downstream of the proposed project is either in existing residential development or grasslands.

The annual rainfall averages about 35 inches over the watershed above the proposed project. About 90 percent of the rain occurs in the five winter months, November through March. The small watersheds which are tributary to Calabazas Creek during the short rainy season result in intermittent streamflows which preclude fish life but do support various animal life that can find water elsewhere during the dry season.

A large portion of the Calabazas Creek floodplain downstream of the proposed project is a developed residential community.

## 1. Environmental Impact of the Proposed Project

The total area involved is about one acre. Vegetation within the site consists of 63 willow trees, four oak trees, seven walnut trees, one Italian Cypress tree, ten sycamore trees, four apricot trees and some native brush and shrubs. Construction is planned so that 42 of the willow trees, all of the oak trees, all of the walnut trees, the Italian Cypress and all of the apricot trees and sycamores will remain. Brush and shrubs along the side slopes of the basin and along the westerly top of bank will also be saved. The net loss of vegetation will consist of 21 small willow trees plus all of the buck brush in the existing basin bottom and along the easterly top of bank.

The removal of brush and undergrowth will reduce small animal habitat by approximately 37,000 square feet.

The basin in operation will reduce very materially the volume of debris and silt which under natural conditions are carried downstream and deposited. The presence of debris and silt has no known beneficial effect of ecological or environmental significance.

The presence of the structure will not interfere with fish life owing to the intermittent character of the stream.

CHECK LIST:

Will the project lead to a noticeable change in the noise level? - No.

Will it displace people? - No.

Will it divide an established community, disrupt orderly planning? - No.

Will it have a significant aesthetic or visual effect? - Yes.

Will it have any effect on areas of unique interest or scenic beauty or on areas now devoted to recreation? - No.

Will it substantially alter the pattern of behavior for a species; interfere with breeding, nesting or feeding? - No.

Will it increase air or water pollution? - No.

Will it adversely affect the water table? - No.

Will it disturb ecological systems such as wildlife, fish and marine life? - No.

Will it have implications for population distribution or concentration, that is a change of population patterns having an effect upon the resource base, including land use, water, energy and public services of the area in question? - No.

What objections have been made to the project by any interested party? - See Appendix One.

## 2. Any Adverse Environmental Effects Which Cannot Be Avoided If The Proposal Is Implemented

We have noted the net loss of trees and brush. The loss of brush habitat while minor in extent is unquestionably an adverse environmental effect. It is presumed that the loss of 21 small willows will have an adverse aesthetic effect.

The vegetation removal cannot be avoided since such vegetation, present in the basin, would by obstruction fatally interfere with its operation in a safe and efficient manner.

The dam including wingwalls will occupy a space about 20' x 40' in area. Despite mitigation noted in the next paragraph, the structure will have an adverse aesthetic effect for some observers.

## 3. Mitigation Measures Proposed To Minimize The Impact

a) The work has been planned to minimize the loss of vegetation.

b) The sterile concrete look of the proposed dam will be minimized in part by the placing of rock instead of further concrete in the downstream area.

c) The basin area will have regular maintenance.

d) Natural ground cover will be disturbed by construction to the least extent possible and will shortly reestablish itself.

e) Further mitigation measures are noted in Appendix One.

## 4. Alternatives To The Proposed Action

The first alternative is no action. The environmental effect can be readily foreseen and would be more detrimental than the action proposed. There is no escaping the necessity of removing debris and silt from the stream bed and banks since their presence will produce unacceptable flooding hazards. Removal at the critical points will require ramps and pioneered roads to the numerous areas affected. Branches are thereby unavoidably broken; trees, shrubs and vegetative cover and fences are removed, and the privacy of adjacent homeowners is compromised.

The most serious silt and debris deposition problems exist for a distance of about three miles downstream from the proposed project site. Three sites were investigated in selecting a basin that would provide protection for the critical reach. Sites were investigated to see if they would provide adequate storage for silt and debris and if maintenance access for silt and debris removal were available. In addition, attention was given to the desirability of a debris basin which would have a minimum effect upon the delicate environmental balance along the creek. A site just upstream of Comer Drive was investigated and was ruled out because a large amount of natural growth would have been removed. In addition, a basin would have had to be excavated to provide adequate storage. A second site investigated is located just downstream from the proposed site. This site had adequate silt and debris holding capacity but access to the site was not readily available. The third site and the one selected has adequate capacity, good maintenance access, and can be built with the least effect upon the environment.

An energy dissipator is required to prevent erosion downstream caused by water flowing over the 5' high dam. Several alternative designs were investigated. A gabion type of structure (wire baskets filled with rock) was considered. It was rejected because there are insufficient experimental data to show: a) effectiveness in preventing downstream erosion, b) water tightness need to slow the flow of water within the debris basin and, c) vulnerability to destruction by floating debris.

A United States Bureau of Reclamation "straight drop" type and a "sloping chute" type of concrete dissipator were reviewed. Both designs are considered efficient but not as aesthetically pleasing as the rugged tooth type proposed. The selected design has the added advantage of being placed so low that the top of the sidewalls are just barely above the surrounding ground, thus eliminating the "mass of concrete" effect. The selected design has been experimentally developed and has been tested both in the laboratory and in the field.

## 5. The Relationship Between The Short-Term Uses Of Man's Environment And The Maintenance And Enhancement Of Long-Term Productivity

Santa Clara County Flood Control and Water District is aware that it is expected to accept its measure of responsibility as a trustee of the environment for succeeding generations rather than as a despoiler intent upon the comfort of the present one. Bearing this fundamental duty in mind, it is not considered that the project's results will be permanently limiting to our ecosystems or the biological community.

## 6. Any Irreversible Environmental Changes Which Would Be Involved In The Proposed Action Should It Be Implemented

It is concluded from the foregoing that such environmental changes as will result are insubstantial and none could fairly be characterized as irreversible in damaging effect.

## 7. The Growth-Inducing Impact Of The Proposed Action

The proposed action will have no recognizable growth inducing impact.

## 8. The Boundaries Of The Area Which May Be Significantly Affected By The Proposed Action

The significant flood control effect of the action may be traced through the length of the stream below the structure proposed. It is not believed that this is the kind of effect the Legislature intended should be the subject of this report. The significant environmental impact is aesthetic and visual. For a number of viewers the impact will be adverse. The boundaries of the affected area in that sense enclose the lands from which the project can be seen.

The Board of Directors of Santa Clara County Flood Control and Water District will, following notice and hearing as required by law, determine the boundaries of the area affected by the project. That determination will be added as an appendix hereto.

# APPENDIX ONE

Objections made to the project by any interested party:

Mrs. Edith Jackson and Mrs. Leroy Garrett, owners of property adjacent to and immediately easterly of the project site made objections through their attorney on the following grounds:

1. That the project will result in the destruction of the ecological beauty of his client's property due to the "stripping of the ground", the "installation of a top service road" and the "placement of the ramp".
2. That the purpose of the project is to enhance the percolation capability of the creek.
3. That the City of Saratoga prevented a similar type of project recently at Wildwood Park on Saratoga Creek.
4. That the project will result in the "complete loss of the country atmosphere".
5. That the project will result in the loss of a beautiful old oak tree and the stripping of many trees and wild shrubs.
6. That the project will leave the landowners with a lot size less than the minimum.

The following responds to the objections specified above:

1. The stripping of the ground, the installation of a top service road and the placement of a ramp once planned for the easterly side of the creek have all been deleted. Access will be directly off of Comer Drive and from the westerly side of the creek only.

2. The purpose of the project is not to enhance the percolation capability of the creek. The purpose of the project is that noted in the foregoing report.
3. Wildwood Park, incorporating a debris basin and a small recreational lake, was finally disapproved upon other than environmental impact grounds.
4. The areas to be cleared of vegetative matter are those needed to construct two earthen access ramps, a concrete and rock energy dissipator and an already widened creek bottom which contains a substantial amount of debris. The number of trees involved in the project are specified under "Environmental Impact of the Proposed Project" of this report. It is not considered that the country atmosphere will be destroyed thereby.
5. The energy dissipator was intentionally aligned to prevent the loss of the beautiful old oak tree. This was one of the essential elements of the initial planning for the project.
6. The size of the lots mentioned will not change if the right-of-way needed for the project is granted as easement rather than fee -- and this will be at the option of the landowners.

DISTRICT MAINTENANCE RECORDS

| CRK | RCH | MLOC | FY | WO | DESCRIPTION | FROM | TO | ACMP | LENGTH | COST | DAYS | CY | CC | ACT | BYY | EYY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Creek No | Maximo Reach Designation | Creek Number and old Maintenance Reach Designation | | Work Order No. | S&D, S/D: silt and debris MOU F K L<br>and/or M: Applicable paragraphs of the MOU with Ca Dept of Fish & Game for improved channels | | | Accomplishments in stations | (feet) | | | cubic yards | cost center | maintenance activities | begin date | end date |
| 2010 | 906 | 2010-F | 78 | NC78-313 | CALABAZAS CK D/S OF COMER TO 550' U/S OF COMER S/D REM | 595+00 | 605+50 | 10 5 | 1,050 | $24,049 00 | 10 | 4,864 | 20 | 1010 | 8/28/78 | 9/13/78 |
| 2010 | 906 | 2010-F | 82 | NC82-172 | CALABAZAS CK COMER DEBRIS BASIN D/S AT COMER DR. S/D REM | 595+00 | 600+00 | 5 | 500 | $21,504 32 | 7 | 6,750 | 20 | 1010 | 8/19/82 | 8/31/82 |
| 2010 | 906 | 2010-F | 82 | NC83-91 | CALABAZAS CK COMER DEBRIS BASIN, S/D REM | 595+00 | 600+00 | 5 | 500 | $21,397.04 | 7 | 4,800 | 20 | 1010 | 2/16/83 | 2/25/83 |
| 2010 | 906 | 2010-F | 83 | NC83-230 | CALABAZAS CK COMER DEBRIS BASIN S/D REM | 595+00 | 600+00 | 5 | 500 | $20,437.57 | 9 | 7,200 | 20 | 1010 | 6/2/83 | 6/22/83 |
| 2010 | 906 | 2010-F | 85 | NC85-163-1 | CALABAZAS CREEK - COMER DEBRIS BASIN - S&D REMOVAL | 597+00 | 603+50 | 6.5 | 650 | $38,247.00 | 12 | 3,140 | 20 | 1010 | 8/13/85 | 8/27/85 |
| 2010 | 906 | 2010-F | 86 | 2086011 | CALABAZAS CREEK - COMER DEBRIS BASIN - S&D REMOVAL | 597+00 | 603+50 | 6.5 | 650 | $53,319.00 | 14 | 9,080 | 20 | 1040 | 8/25/86 | 9/11/86 |
| 2010 | 906 | 2010-F | 90 | 2090103 | CALABAZ.CRK/COMER DEB BASIN S&D REM MOU F K L M | 595+00 | 600+00 | 5 | 500 | $35,465.50 | 17 | 7,500 | 20 | 1010 | 11/1/90 | 11/14/90 |
| 2010 | 905 | 2010-E | 91 | 2091185 | CALABAZAS CRK - COMER DR - REMOVE S&D (MOU)-K | 598+00 | 602+00 | 4 | 400 | $50,634.40 | 27 | 3,730 | 20 | 1010 | 9/23/91 | 10/8/91 |
| 2010 | 906 | 2010-F | 92 | 2092121 | CALABAZAS CRK - U&D/S COMER - S&D REMOVAL(MOU)-1M | 595+00 | 603+50 | 8.5 | 850 | $84,237.20 | 15 | 7,500 | 20 | 1010 | 8/1/92 | 8/18/92 |
| | | | 14 | 9 times | | | | | | | | | | | | |
| 2010 | 906 | 2010-F | 80 | NC80-310 | CALABAZAS CK D/S COMER DR S/D REM | 595+00 | 600+00 | 5 | 500 | $28,238.00 | 12 | 5,837 | 20 | 1010 | 8/18/80 | 9/26/80 |
| 2010 | 906 | 2010-F | 81 | NC81-220 | CALABAZAS CK D/S COMER DR S/D REM | 595+00 | 600+00 | 5 | 500 | $16,958.00 | 9 | 3,980 | 20 | 1010 | 9/17/81 | 9/29/81 |

1978

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C
C 11.
C 35336.TAN TAU
C 36540.HY. 280, DBL. 12'X13'X180' BOX CULVERT
C 37525.VALLCO PARK, DBL. 11' X 9' X 1590' BOX CULVERT
C 38588.STEVENS CREEK BLVD.
C 39951.MILLER RD. 9' X 12' SBC, WARPED AND MITRED WW, W/ ENERGY SILL DOWNSTREAM
C 41081.TRIBUTARY ENTERING FROM WEST
C 44631.BOLLINGER RD. 8'X12'X32'SBC, W/ 7.6' DROP IN BRIDGE TO 15.6'X20' SBC
C 47591.TRIBUTARY ENTERING FROM SOUTH, RODEO CR.
C 47731.BLANEY AVE.12'X12'X64' SBC, W/ 4'DROP AT UPSTREAM WW, 2' DROP AT
C 47731.DWNSTRM WW'S, WARPED WW'S
C 49292.RAINBOW AV. 8'X12'X106' SBC, W/ 2'DROP AT DWNSTRM.WW, WARPED WW'S
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 34075 TO STA. 52362--500YEARFLOOD--FINAL
J1-1.   2.                      .008            -1.            145.
J21.
J338.   23.     24.     42.     43.     26.     7.      6.      53.     54.
J34.    3.      0.      38.     43.     14.     13.     15.     34.     1.
J327.   28.     4.      61.     50.
NC.05   .05     .05     .05     .2
QT6.    2000.   1950.   1900.   1700.   2400.   2200.
X133819.      9.981.    1020.        16.     16.     16.         -997.50
GR1150.4     952  1150.1     968  1150.4     975  1148.5     981  1138.8     995
GR1138.5    1004  1148.3    1020  1149.1    1022  1149.8    1039
NC 0.05    0.050   0.050    0.05    0.20
X134075.      7.969.    1027.       256.    256.    256.         -997.50
GR1151.7     953  1151.0     969  1140.0     992  1140.0    1008  1140.9    1010
GR1150.9    1027  1151.0    1039
X134323.      8.967.    1026.       248.    248.    248.         -997.50
GR1154.2     952  1154.5     967  1141.8     991  1141.8    1009  1145.0    1017
GR1151.0    1026  1152.5    1030  1153.0    1041
X134560.7.      974.    1026.   237.    237.    237.    1.      -997.5
GR1156.0     950  1156.1     971  1155.0     974  1142.0     990  1142.0    1010
GR1154.21026.   1155.   1037.
ET      9.1     9.1     9.1                                             1027.
X134978.11.     966.    1023.   418.    418.    418.            2.5
GR159.2 950.    159.6   961.    158.6   966.    146.    986.    144.5   1000.
GR144.  1004.   144.    1009.   145.8   1012.   155.    1023.   157.    1027.
GR156.  1052.
ET      9.1     9.1     9.1                                             1029.
X135313.9.      982.    1018.   335.    335.    335.            2.5
GR160.  942.    160.2   979.    159.3   982.    150.    995.    150.4   1004.
GR159.5 1018.   160.2   1021.   160.    1029.   159.9   1051.
NC.05   .05     .015    .1      .3
X135336.4.      989.9   1010.6  23.     23.     23.             2.5
GR158.9 989.9   150.6   990.    150.6   1010.5  158.9   1010.6
SB1.25  1.25    2.5     120.    20.5    .5      160.            153.4   153.1
QT6.    3360.   2700.   2490.   1950.   3360.   2700.
X135418.4.      989.9   1010.6  82.     82.     82.             2.5
X2              1.      158.9   161.3
GR161.1 989.9   150.6   990.    150.6   1010.5  161.1   1010.6
X135440.8.      981.    1020.   22.     22.     22.             2.5
GR160.7 940.    160.9   960.    161.    981.    151.    995.    151.    1005.
GR160.9 1020.   160.    1040.   159.8   1053.
NC              .035    .1      0.2
ET      9.1     9.1                                                     1032.
X135658.11.     976.    1027.   218.    218.    218.            2.5
GR163.9 940.    163.6   972.    162.4   976.    152.4   990.    151.8   993.
GR151.9 1005.   152.6   1008.   154.    1012.   163.9   1027.   164.8   1032.
GR164.5 1055.
X136098.12.     972.    1023.   440.    440.    440.            2.5
GR164.8 941.    164.8   948.    164.4   961.    163.9   969.    163.    972.
GR154.2 988.    152.6   1011.   153.6   1014.   155.    1016.   164.    1023.
GR166.  1029.   166.2   1067.
X136494.11.     969.    1029.   396.    396.    396.            2.5
GR168.  939.    167.5   969.    155.9   985.    155.4   987.    155.5   1012.
GR156.  1013.   158.4   1016.   167.2   1029.   168.    1038.   167.8   1052.
GR168.  1067.
NC              .015                                            2
X136540.8.      390.    440.    46.     46.     46.
X310.                                                   162.9   162.9
GR170.  0.      170.    380.    168.    390.    154.9   390.5   154.9   416.5
GR168.  417.    170.    440.    171.    850.
SB1.20  1.56    2.6     .5      26.5            312.             155.5  154.9
X136725.9.      420.    455.    185.    185.    185.
X2              1.      167.5   173.2
X310.                                                   163.4   163.4
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BT9.    0.      173.2   172.    400.    173.4   170.    420.    173.5   172.
BT425.  173.5   155.5   425.1   173.5   167.5   450.    173.5    167.5  450.1
BT173.5 155.5   455.    173.5   172.    800.    175.    173.
GR172.  0.      170.    400.    172.    420.    155.5   425.    155.5   425.1
GR155.5 450.    155.5   450.1   172.    455.    173.    800.
NC.04   .04     .015    .1      .3
X136785.6.      372.    432.    60.     60.     60.
GR170.  0.      170.    372.    155.7   399.    155.7   418.    170.2   432.
GR172.  840.
NC              .022
X136815.                        30.     30.     30.             1.
X136915.8.      36.     104.    100.    100.    100.
GR173.          165.1   18.     165.    36.     157.1   60.     157.1   80.
GR165.  104.    165.1   122.    173.    140.
X137115.                        200.    200.    200.            .3
X137315.                        200.    200.    200.            .3
X137495.                        180.    180.    180.            .27
NC              .015
X137525.7.              24.8    30.     30.     30.
GR169.          158.02  .1      158.02  13.     169.    13.1    158.02  13.8
GR158.0224.7    169.    24.8
X137715.                        190.    190.    190.            .38
X137915.                        200.    200.    200.            .4
X138115.                        200.    200.    200.            .4
X138285.                        170.    170.    170.            .34
X138315.4.              18.1    30.     30.     30.
GR171.1         160.05  .1      160.05  18.     171.1   18.1
X138415.                        100.    100.    100.            6.7
SB.9    2.21    2.6     .5      18.5            198.            167.7   157.2
X138588.6.      350.    368.1   273.    273.    273.
X2              1.      178.7   184.
X310.                                                   178.7   178.7
BT6.    0.      184.    184.    350.    185.    185.    350.1   184.    178.7
BT368.  184.    178.7   368.1   186.    186.    560.    188.    188.
GR184.  0.      185.    350.    167.7   350.1   167.7   368.    186.    368.1
GR188.  560.
NC   .05     .05    .035      .1      .3
QT6.    2670.   2000.   2050.   1670.   2670.   2210.
ET      9.1     9.1     9.1                                     200.    400.
X138603.6.      200.    218.1   15.     15.     15.
GR184.5         186.    200.    174.5   200.1   174.5   218.    186.    218.1
GR187.  400.
ET      9.1     9.1                                             255.
X138700.6.      255.    325.    97.     97.     97.
GR184.          189.    255.    176.    290.    176.    305.    186.    325.
GR188.  400.
X139011.8.      175.    225.      311.      311.    311.
GR 190.5       0     190      10     190     175     180     185   178.5     200
GR   180     210     190     225     190     240
ET      9.1     9.1                                             60.
X139351.9.      165.    230.    350.    360.    340.
GR 192.2       0     192      40     194      60     194     165     192     170
GR   182     190   180.7     200     182     205     194     230
X139591.       7     175     227     250     230     240
GR 196.7       0     196      84     194     175     184     190     182     200
GR   184     208     196     227
X139871.       9     180     227     275     280     280
GR   197       0     196     150     196     180     190     188     188     192
GR   186     200     188     210     190     213     196     227
X139911.      10      50      98      40      40      40
GR   196       0     196      50     190      58     188      64     186      64
GR   186      80     188      80     190      83     196      98     196     130
NC              .015    .3      .6
QT6.    1600.   1600.   1550.   1400.   1600.   1600.
X139951.       8      60      75      40      40      40
X310.                                                   194.18  194.18
GR   197       0     197      60  194.18      60  185.18      60  185.18      72
GR194.18      72     197      72     197     135
SB      1.55    2.6             12.             108.            186.33  185.18
QT6.    3740.   2830.   2500.   1740.   3740.   2830.
X140042.       6      60      75      91      91      91
X2     0       0       1  195.23     197       0       0       0       0       0
X310.                                                   195.33  195.33
BT6.    0.      197.    197.    60.     197.    197.    60.     199.5   195.33
BT75.   199.5   195.33  75.     197.    197.    135.    197.    197.
GR   197       0     197      60  186.33      60  186.33      75     197      75
GR   197     135
X140062.       6      45      86      20      20      20
GR   198       0     196      45     188      56     188      64     198      86
GR   199     130
NC              .035    .1      .3
X140081.      10     175     230      19      19      19
GR   199       0     198      95     200     145     198     175     190     190
GR 188.2     200     190     209     198     230     200     260   200.3     400
X140431.       9     170     238     350     360     350
GR   204       0     204     170     200     180     190     195   189.7     200
GR   190     205     192     220     204     238     206     350
X140651.      11     162     245     215     220     220
GR 206.9       0     206      80     206     162     202     165     198     175
GR   192     190     191     196     191     204     192     210     206     245
GR   206     400
X140911.      10     168     231     275     265     260
GR 210.2       0     210     155     208     168     194     185   192.5     192
GR 192.5     205     194     212     200     222     208     231   208.1     250
QT6.    2610.   1950.   1700.   1170.   2610.   1950.
X141081.      10     165     225     160     170     170
GR 210.4       0     210     165     200     180     194     197   193.5     200
GR   194     203     200     218     210     225     212     240     212     310
X141261.      12     167     239     190     170     180
GR   214       0     214     155     212     167     210     175     200     185
GR   196     196   194.5     200     196     212     200     225     210     232
GR   212     239   212.5     265
ET      9.1     9.1                                             40.
X141561.      11     128     235     250     340     300
GR 215.5       0     216      40     216     115     214     128     198     185
GR 196.1     200     198     208     200     213     210     228     214     235
GR 214.2     245
ET      9.1     9.1                                             160.
X141851.      12     160     278     240     265     290
GR   215       0     216      48     218     160     216     173     210     175
GR   200     186     198     195   197.1     200     198     208     214     251
GR   216     278   216.2     295
ET      9.1     9.1                                             90.
X142171.       9     170     230     335     290     320
GR   218       0   218.8      90     218     170     210     181     200     192
GR 198.2     200     200     209     210     215     218     230
ET      9.1     9.1                                             85.
X142601.       9     150     219     420     400     430
GR   220       0     220     150     210     168     200     198   199.5     200
GR   200     204     210     215     220     219   220.5     225
X142821.      12     180     242     205     255     220
GR 219.5       0     220      85     220     180     210     192     202     196
GR 200.9     200     202     204     210     212     220     218     222     242
GR   224     285   224.2     305
ET      9.1     9.1                                             63.
X143201.      13     158     235     385     355     380
GR 222.5       0     224      63     224     158     220     168     210     178
GR   204     198   203.5     200     204     205     210     213     220     217
GR   222     228     224     235   224.5     250
ET      9.1     9.1                                             65.
X143491.      13     150     235     310     280     290
GR   226       0     228      65     228     150     222     168     220     177
GR   210     190     206     197   204.8     200     206     203     210     216
GR   220     225     224     235   224.2     245
X143781.      12     160     240     280     310     290
GR   228       0     228     160     220     177     210     185     208     192
GR   206     198   205.9     200     206     203     208     209     210     219
GR   220     234     228     240
X144071.      10     170     232     290     345     310
GR 229.8       0     230      50     230     170     220     180     210     193
GR 208.1     200     210     217     220     227     230     232   230.1     242
ET      9.1     9.1                                             168.
X144261.      11     168     235     170     170     170
GR 231.8       0     232     168     230     172     220     183     210     193
GR   209     200     210     211     220     221     230     232     232     235
GR   232     240
X144561.      10     160     255     300     300     300
GR 235.9       0     234     160     230     173     220     180     216     185
GR 214.2     200     216     214     220     222     230     245     232     255
NC              .015    .35     .55
X144621.       9      70     125      60      60      60
GR   234       0     234      20     232      70     220      75     216      81
GR   216     105     218     110     234     125     234     150
QT6.    1650.   1650.   1650.   1170.   1650.   1650.
X144631.       6      66      86      10      10      10
GR   234       0  230.41      66   214.7      66   214.7      86  230.41      86
GR   234     152
X144668.       0       0       0      37      37      37       0
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X144672.       4       0      12       4       4       4
BT     2       0     234  230.41      12     234  230.41
GR230.41       0  222.41       0  222.41      12  230.41      12
SB      1.52    2.6             12.             96.             222.41  222.4
X144702.9.           215     275      30      30      30
X2     0       0       1  230.41   234.0       0       0       0       0       0
X310.                                                   230.41  230.41
BT9.            235.9   234.4   180.    234.    234.    215.    234.    234.
BT223.  234.    222.41  223.    234.    230.41  235.    234.    230.41  235.
BT234.  222.41  275.    234.    232.    450.    234.    234.
GR234.4         234.    180.    234.    215.    222.41  223.    222.41  223.1
GR222.41235.    222.41  235.1   232.    275.    234.    450.
QT6.    2610.   1950.   1700.   1170.   2610.   1950.
X144711.      12     170     230      20       9       3
GR 236.5       0     238      65     238     105     236     170     226     185
GR   224     193     222     200     224     208     228     215     230     225
GR   232     230   232.1     235
NC              .035    .1      .3
ET      9.1     9.1                                             40.
X144951.      10     175     230     250     225     240
GR   238       0     240      40   240.2      75     240     135     238     175
GR   226     195   225.5     200     226     205     228     215     236     230
X145026.      10      75     140      75      75      75
GR 240.2       0     240      30     238      75     232      88     228      90
GR   226      93     226      99     228     110     230     118     236     140
NC              .02     .4      .6
X145046.       6      91   110.5      20      20      20
X310.                                                   237.    237.
GR   239       0     239      91     226      91     226   110.5     239   110.5
GR   239     140
SB      1.49    2.6             19.5            209.            226.2   226.
X145066.       8      91   110.5      20      20      20
X2     0       0       1   236.3     239       0       0       0       0       0
X310.                                                   237.2   237.2
BT8.            239.    239.    90.     239.    239.    91.     239.    236.
BT91.   239.    236.3   110.5   239.    236.5   110.5   239.    236.5   112.
BT239.  239.    140.    239.    239.
GR   239       0     239      90   236.3      91   226.2      91   226.2   110.5
GR 236.3   110.5     239     112     239     140
X145086.      10      65     114      20      20      20
GR   240       0     240      12     238      65     232      72     228      72
GR   227      85     228     100     230     105     238     114   238.5     240
NC              .035    .1      .3
X145181.      10     166     255      95      95      95
GR   240       0     240     140     238     166     228     191   226.8     200
GR   228     213     230     225     236     240     238     255     240     300
ET      9.1     9.1                                             55.
X145431.      13     171     253     240     300     250
GR 241.5       0     242      55     244     135     242     171     240     177
GR   230     182     228     190   227.5     200     228     206     230     215
GR   238     235     240     253     242     265
X145721.      10     140     230     300     235     280
GR   246       0     246      90     244     140     236     155     230     188
GR 228.5     200     230     211     240     220     244     230     244     240
X146011.      12     165     243     240     350     290
GR   244       0     244      40     246      65     246     165     240     179
GR   232     191     230     200     232     210     240     220     242     225
GR   246     243     248     275
X146321.      12     165     245     315     305     310
GR   246       0     246      25     248      60     248     165     240     175
GR   234     190     232     200     234     210     240     225     244     228
GR   248     245     250     280
X146621.      10     153     235     350     460     300
GR   252       0     252     153     250     165     240     180     236     190
GR 234.3     200     236     212     248     235     248     310     249     350
X146761.      11     112     232     125     145     140
GR 252.1       0     252     112     250     135     246     172     240     179
GR   236     190   235.5     200     236     209     240     220     250     232
GR   251     255
X147011.      11     165     227     290     215     250
GR   254       0     254     130     252     165     250     171     240     185
GR   238     193   236.7     200     238     210     240     217     250     227
GR   251     260
NC     .05     .05     .04
X147181.      11     163     250     155     185     170
GR   254       0     254     120     252     163     250     168     240     181
GR   238     185   237.3     200     238     215     240     228     250     240
GR   252     250
X147411.      10     170     240     215     265     230
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GR   256       0     256     160     254     170     250     180     240     190
GR 238.2     200     240     210     250     230     256     240     256     330
QT6.    2010.   1610.   1400.   940.    2010.   1610.
X147591.      11     165     239     220     160     180
GR   259       0     258     165     256     178     254     182     250     185
GR   242     195     240     200     242     209     246     212     256     239
GR   256     260
NC              .015    .25     .40
X147699.       7      20      80     108     108     108
GR   258       0     258      20     242      43     242      63     254      80
GR   256     100     256     150
X147731.       8      51      63      32      32      32
X310.                                                   255.43  255.43
GR   257       0     257      50  255.53      51  243.43      51  243.43      63
GR255.53      63     257      64     257     120
SB      1.46    2.60            12.             144.    243.57  243.43
X147792.       6      50      62      65      65      65
X2     0       0       1  255.53     257       0       0       0       0       0
X310.                                                           255.57  255.57
BT6.            257.    257.    50.     257.    257.    50.     258.    255.57
BT62.   258.    255.57  62.     257.    257.    120.    257.    257.
GR   257       0     257      50  243.57      50  243.57      62     257      62
GR   257     120
X147812.      10      35      77      20      20      20
GR   258       0     258      15     257      35     256      37     246      47
GR   246      57     256      72     257      77     258      80     258     115
NC              .04     .1      .3
X147862.      11     165     220      50      50      50
GR   260       0     260      80     258     165     256     175     250     182
GR 248.1     195   248.1     204     250     205     256     214     258     220
GR   259     235
ET      9.1     9.1                                             72.
X148062.      12     180     225     195     190     200
GR 261.5       0     262      72     262     131     260     180     258     185
GR   250     193   249.5     197   249.5     202     250     208     260     221
GR   262     225     262     245
X148262.      10     165     222     205     195     200
GR 263.2       0     262     140     260     165     258     182     252     194
GR   251     198     251     202     252     204     262     222     263     240
X148462.       9     180     227     210     200     200
GR   264       0     262     160     260     180     258     185   256.1     198
GR 256.1     203     258     212     264     227     264     235
X148562.      13     185     222     100     100     100
GR 266.1       0     266       5     264      45     260      65     262     145
GR   262     185     258     190   256.2     196   256.2     204     258     206
GR   264     215     266     222     266     234
X148762.      11     174     235     210     190     200
GR   267       0     266      52     264     112     262     174     258     182
GR 257.2     192   257.2     208     258     220     260     224     266     235
GR 266.2     240
X148962.      12     170     215     185     190     200
GR 268.1       0     268      42     266      70     264     170     262     172
GR   260     175     258     184   257.8     196   257.8     204     258     205
GR   268     215   268.1     220
ET      9.1     9.1                                             14.
QT6.    1370.   1310.   1070.   750.    1370.   1310.
X149162.      10     182     228     205     195     200
GR   268       0     270      14     270     150     268     182     260     190
GR 259.2     198   259.2     203     260     212     270     228     270     240
NC              .015    .27     .45
ET      9.1     9.1                                             159.
X149262.      11     168     228     105     100     100
GR 271.6       0     272     159     270     168     268     170     266     176
GR   262     180   260.2     190   260.2     210     268     226     270     228
GR 271.8     237
X149292.       8      84      96      30      30      30
X310.                                                   269.1   269.1
GR 271.8       0   271.8      84   269.6      84  261.08      84  261.08      96
GR 269.6      96   271.8      96   271.8     150
SB      1.44    2.6     150.    12.             96.             261.6   261.08
X149402.       6      84      96     110     110     110
X2     0       0       1   269.6   271.8       0       0       0       0       0
X310.                                                           269.6   269.6
BT6.            271.8   271.8   84.     271.9   271.8   84.     273.2   269.6
BT96.   273.2   269.6   96.     271.9   271.8   150.    272.    271.8
GR 271.8       0   271.8      84   261.6      84   261.6      96   271.8      96
GR 271.8     150
X149432.       8      70     110      30      30      30
GR 273.5       0     272      45     270      70     262      85     262      97
GR   270     110     272     114     272     150
NC              .04     .1      .3
X149462.      12     162     220      30      30      30
GR   275       0     274      38     272     162     270     183     264     190
GR 261.2     192   261.2     208     268     210     272     214     274     220
GR   274     236   274.1     240
X149662.      10     170     233     220     215     200
GR   274       0     274      84     272     170     270     172     264     192
GR 263.9     196   263.9     204     264     207     274     233     274     236
ET      9.1     9.1                                             44.
X149862.      15     168     250     195     190     200
GR 275.7       0     276      44     276     156     274     168     272     176
GR   268     188     266     191   263.6     195   263.6     205     266     214
GR   266     214     270     222     272     231     274     239     276     250
X149962.      12      36     218      50     265     100
GR   279       0     278      36     276      52     274      85     272     110
GR   270     131     268     188   266.3     195   266.3     206     270     209
GR   276     216   276.5     218
X150062.15.     168.    229.    100.    100.    100.
GR   280       0     278      42     276      68     274     110     276     168
GR   274     175     272     178     270     180     268     192   267.2     194
GR 267.2     205     268     209     270     219     276     227     278     229
EJ
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 34075 TO STA. 52362--100YEARFLOOD--PRELIMINARY
J1-1.   3.                      .008            -1.             45.
J22.
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 34075 TO STA. 52362-- 50YEARFLOOD--PRELIMINARY
J1-1.   4.                      .008            -1.             45.
J23.
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 34075 TO STA. 52362-- 10YEARFLOOD--PRELIMINARY
J1-1.   5.                      .008            -1.             45.
J215.


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C
C 12.
C 51862. CROSS SECTIONS FROM WATER DISTRICTS DECK AND STRIP TOPO, BRIDGES FIELD
C 51862. CHECKED AND MODIEFED.  CROSS SECTION READ LF. TO RT. LOOKING UP STREAM,
C 51862. CROSS SECTIONS FROM PROSPECT TO UPSTREAM OF SPRR EXTENTED FPR WIDER
C 51862. FLOOD PLAIN.
C 52907.PROSPECT RD. 5.8'X12'680' SBC.
C 52907.PROSPECT RD. 5.8'X12'680' SBC, W/ HALF CIRCULAR OPENING ON UPSTRM END
C 52907.OLD BRIDGE SECTION, SACKED WARPED, AND VERT. WW'S
C 52907.APPOX CAPACITY OF BRIDGE 750CFS REMAINDER SPILLS OVER ROAD OR NORTH
C 55262.SPRR. CROSSING, 4'X13' SIMPLE BRIDGE, W/ VERTICAL AND MITRED WW'S,
C 55262.APPOX. 400CFS WEIRS OVER TRACKS BACK IN TO FLOODPLAIN, 200 SPILLS DOWN
C 55262.TRACKS AND REENTERS AT SARATOGA-SUNNVALE ROAD
C 57572.WARDELL RD. 8'X18' OPENING, VERTICAL WW'S
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 52562 TO STA. 58462--100YEARFLOOD--FINAL
J1-10.  7.                                      -1.             289.7
J21.
J338.   43.     14.     42.     4.      53.     54.     25.     27.     28.
J350.   61.     0.      38.     43.     23.     24.     26.     7.      6.
J353.   54.     34.     4.      3.      1.
NC.05   .05     .03     .1      .3
QT6.    1220.   1780.   1000.   850.    1.      1780.
ET              10.4
X151862.      10     184     304     260     195     200
GR 290.5       0     290     184   284.4     195   284.4     205     286     216
GR   288     233     290     250     292     272     294     304     294     400
X152062.       9     174     255     300     195     200
GR   291       0     292      60     292     174   285.9     194   285.9     206
GR   290     218     292     255     294     358     295     400
X152162.       7     187     222     110     105     100
GR   292       0     292     187   286.5     195   286.5     208     292     222
GR   294     378     294     400
X152262.       9     187     232      70     150     100
GR   292       0     292     187   286.5     195   286.5     208     287    210.
GR288.  212.    292.    232.    292.    330.    292.    400.
X152362.       9     140     212      80     150     100
GR   297       0     296     140     294     162     292     180     288     190
GR 287.8     195   287.8     203     292     212     293     275
X152562.       8     180     225     210     195     200
GR   297       0     298     180     290     193     289     196     289     207
GR   290     215     296     225     298     400
X152762.      10     182     218     225     195     200
GR   297       0     296      41     296     165     296     182     292     192
GR   291     195     291     206     292     209     298     218   298.5     240
NC     0       0    .025
QT      750.    750.        750.    750.             750
X152862.       8     182     220     105     100     100
GR   299       0     298     182     294     190   293.5     195   293.5     203
GR   294     215     298     220     300     300
NC     0       0    .015        .35     .40
X152907.       8      69      81      45      45      45
X310.                                                   299.6   299.6
BT       6       0     300     300      66     300     300      69     300   299.6
BT      81     300   299.6      84     300     300     150     300     300
GR   300       0     300      66   299.6      69   294.1      69   294.1      81
GR 299.6      81     300      84     300     150
QT      1820.   1780.   850.                    1780.
SB      3.34    2.6             12.             66.             297.    294.1
X153587.12.     260.    295.    680.    680.    680.
X2              1.      302.5   304.
X310.                                                   302.5   302.5
BT12.   0.      308.    308.    110.    307.    307.    210.    306.5   306.
BT260.  306.    304.    270.    306.    297.    270.1   306.    302.5   286.
BT306.  302.5   286.1   306.    297.    295.    306.    302.    330.    304.
BT304.  390.    304.    304.    390.    314.    314.
GR308.  0.      307.    110.    306.    210.    304.    260.    297.    270.
GR297.  270.1   297.    286.    297.    286.1   302.    295.    304.    330.
GR304.  390.    314.    390.
X153597.      10      57     108      10      10      10
GR   306       0     304      57     302      65     300      67     298      70
GR 297.1      75     298      90     300      95     302     108     306     140
NC     0       0     .04
ET              10.4
X153662.11.          162.218.   65.     65.     65.
GR 307.5       0     306     150     302     162     300     185   297.8     195
GR297.8 205.    300.    210.    302.    218.    304.    275.    304.    290.
GR314.  290.
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QT      1590.   1570.   1400.   880.                1570
X153862.10.     173.    218.    220.    205.    200.
GR 309.5       0     310     120     308     173     302     188   300.5     195
GR300.5 208.    302.    212.    304.    218.    306.    300.    308.    410.
X154062.       9     176     268     215     195     200
GR 310.3       0     310     176     308     186     302     192   301.8     194
GR 301.8     208     304     220     306     253     310     268
X154262.9.      167.    218.    210.    290.    200.
GR 311.2       0     310     167     306     185   304.5     194   304.5     210
GR306.  212.    308.    218.   308.5    233.    310.    420.
ET              8.4
X154462.9.      277.    314.    210.    210.    200.
GR  313        0     312     277     308     285   306.5   287     306.5   299
GR  308      307     310     314     310     337     311   402
ET              10.4
X154800.      10     555     595     338     338     338
GR 314         0   314.8     380     316     500     316     540     312     555
GR308.9   570     308.9     580     314     595     316     635   316.5    660
X154958.      07     528     617     158     158     158
GR 316.              314     528   309.8     592   309.8     607     316     617
GR 317.5     640   325.      641
QT6.    990.    900.    860.    580.            900.
X155162.9.      478.    520.    204.    204.    204.
GR   318       0     316     180     316     450     316     478     311     484
GR   311     508     316     520     318     584     320     600
X155252.      14     137     167      90      90      90
GR   318       0     318      65     319      95     318     110     316     137
GR   314     140     312     142   311.5     144   311.5     154     312     158
GR   314     159     316     167     318     230   317.9     300
NC      0       0     .02    .35     .6
QT      700.    700.    700.                    700.
X155262.       8     144     157      10      10      10
X310.                                                   317.4   317.4
GR   320       0     320     144  317.48     144  313.04     144  313.04     157
GR317.48     157     320     157     320     300
QT      1580.   1180.   1000.   580.            1180.
ET              9.1                                             440.    633.5
SB      1.69    2.6     300.    13.             55.12           313.24  313.04
X155297.      9.     620   633.1      35      35      35
X2             1.      317.6   319.5
X310.                                                   317.6   317.6
BT6.            322.    322.    135.    320.    320.    170.    319.5   319.5
BT460.  319.4   319.4   620.    320.5   320.5   620.1   320.5   317.6
GR   322       0     320     135  319.5      170  319.5      460   320.5     620
GR313.3 620.1   313.2   633.    320.5   633.1   322.    790.
NC      0       0     .04       .1      .3
QT                                                  1180
ET              9.1                                             105.    210.6
X155307.       7     140     162      10      10      10
GR 319.8       0     318     140     314     140     312     143     312     155
GR   318     162     320     300
ET              9.1                                             145.    210.
X155362.       8     188     210      55      55      55
GR 319.8       0     318     188     316     194   312.2     196   312.2     204
GR   314     205     318     210     319     243
ET              12.4
X155562.       8     185     240     225     195     200
GR   320       0     320     185     316     193   314.7     195   314.7     205
GR   316     211     320     221     322     240
ET      9.1      8.4    9.1     9.1                  9.1              70     270
X155762.      10     186     225     220     200     200
GR 319.4       0     322      70     322     186     318     192     317     195
GR   317     204     318     207     320     212     322     225     324     270
ET      9.1     12.4    9.1     9.1
X155962.       9     187     218     210     205     200
GR   322       0     324     167     324     187     320     193     319     196
GR   319     205     320     208     324     218     326     360
ET      9.1          3.49.1     9.1                  9.1             167     310
X156162.      10     193     210     195     205     200
GR   324       0     326      59     326     100     326     193     322     195
GR 321.2     198   321.2     204     322     205     326     210     328     310
ET      9.1        11.4          9.1      9.1        9.1              59     248
X156362.       8     171     210     205     205     200
GR 326.8       0     328     171     324     185     323     196     323     204
GR   326     206     330     210     330     248
ET      9.1        7.4          9.1      9.1         9.1              45     340
X156562.       8     186     213     200     200     200
GR 328.9       0     330      45     330     186     326     193   326.8     197
GR 326.8     202     330     213     332     340
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ET      9.1        6.4          9.1      9.1         9.1              92     420
x156762.9.      186.    215.    210.    205.    200.
GR 329.5       0     330      69     332      92     332     186   327.2     196
GR327.2 204.    330.    206.    332.    215.    334.    420.
ET      9.1       13.4          9.1      9.1         9.1             115     255
x156962.       8     185     255     210     205     200
GR     333       0     334     115     334     185   330.5     197   330.5     202
GR     332     215     334     225     336     255
ET      9.1        3.4          9.1      9.1         9.1              70     345
x157162.       8     185     213     220     200     200
GR     336       0     336      38     338      70     338     185   331.2     198
GR   331.2     202     338     213     340     345
ET      9.1       10.4          9.1      9.1         9.1             100     340
x157362.       9     185     218     210     210     200
GR     341       0     342     100     342     165     340     185   332.3     197
GR   332.3     202     340     218     342     337     344     340
x157462.       7     175     225     100     100     100
GR     345       0     342     175     340     190   333.5     198   333.5     202
GR     340     210     342     225
x157557.      10      29      73      95      95      95
GR     345       0     344      29     340      33     335      35     334      48
GR     334      55     340      60     342      68     344      73     344     100
NC       0       0     .02        .35     .55
x157572.       8      41      59      15      15      15
BT       6       0   345.5   345.5      41   345.5     342      43   345.5     344
BT      57   345.5     344      59   345.5     342     100   345.5   345.5
GR     345       0     342      41  335.34      41  335.34      43  335.34      57
GR335.34      59     342      59   345.5     100
SB      1.49    2.6             18.             140.            336.    335.34
x157597.       8      41      59      25      25      25       0       0       1
X2       0       0       1     344   345.5       0       0       0       0       0
BT8.            345.    345.    41.     345.    342.    41.1    348.    342.
BT43.   348.    344.    57.     348.    344.    59.     348.    342.    59.1
BT345.5 342.    100.    345.    345.
GR345.5         342.    41.     336.    41.1    336.    43.     336.    57.
GR     336      59     342    59.1   345.5     100
NC       0       0     .04        .1      .3
x157607.11.     28.     67.     10.     10.     10.
GR     346       0     344      28     340      33     338      43   336.2      48
GR   336.2      54     338      57     342      63     344      67     344     100
GR345.   300.
x157662.      11     158     212      55      55      55
GR   356.2       0     356      10     352      34     350      50     358     158
GR     338     193   336.5     198   336.5     203     338     205     344     212
GR   344.1     235
x157862.      10     162     215     220     205     200
GR     360       0     358     105     358     162     350     187     340     192
GR   338.7     198   338.7     202     340     208     344     215     346     235
x158062.      10     164     240     200     225     200
GR   369.5       0     368      39     364      58     362     118     360     164
GR     342     195   340.3     198   340.3     202     342     205     350     240
x158262.       8     165     250     205     220     200
GR     358       0     356     165     344     192   342.2     195   342.2     202
GR     344     208     352     250     354     293
x158462.       7     170     230     220     185     200
GR   356.8       0     356     170     345     196     345     203     350     219
GR     358     230     360     310
EJ
T1      GEORGE S. NOLTE AND ASSOCIATES                          300.76.26.5
T2      STORAGE DISCHARGE ANALYSIS--P.JORGENSEN
T3     CALABAZAS CREEK  STA. 52562 TO STA. 58462--10 YEARFLOOD--FINAL
J1-10.   5.                                     -1.             287.5
J215.


ER
J
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1978

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C        6
C    59000        COMER DRIVE - 5'X30.5' SIMPLE BRIDGE
C    62662        PIERCE RD-CHALET CLOTHILDE DR.- 12'X19.5' SIMPLE BRIDGE
C    63596        PIERCE RD NR QUARRY RD - 19'X40' SIMPLE BRIDGE
C    66216        VIA REGINA - 48" RCP
C    66850        VISTA REGINA - 8.5'X15' SIMPLE BRIDGE
C    69696        DISTRICT'S JURISDICTION LIMIT
T1      CALABAZAS CREEK PLANNING STUDY          12-1978  E.SO
T2      STATIONING FROM U/S TO D/S - REVISED BY E. SO   S.C.V.W.D.
T3      CALABAZAS U/S OF WARDELL - 100-YEAR FLOOD- RESTATIONED 12/88 G. SHEPHARD
J1       0       3       0       0       0       0       0       0   350.3       0
J2      -1
J3      38      42      21      22      13      14      15      25       1       2
J3      26       8       4     100     105
NC    0.05    0.05    0.04     0.1     0.3
QT       3    1580    1180     580
X1   57596       7     170     230     220     185     200
GR   356.8       0     356     170     345     196     345     203     350     219
GR     358     230     360     310
X1   57996       9      52     110     390     420     400
GR     362       0     360      52     358      58     350      70     349      76
GR     349      82     350      90     360     110     364     120
X1   58396       9      66     128     420     360     400
GR     368       0     366      32     360      66     354      94   353.7     100
GR   353.7     108     354     110     360     128     370     160
QT       3            1020     525
X1   58896       9       0      94     400     650     500
GR     374       0     370       9     366      19     365      26     365      54
GR     366      74     370      90     372      94     374     150
X1   59000       6      25    55.5     100      90     104
GR     373       0  372.74      25   365.4      25   365.5    55.5  372.56    55.5
GR372.71    80.5
X1   59036       6      25      56      36      36      36
GR373.04       0  372.57      25   365.5      25   365.6      56  372.43      56
GR372.61      81
X1   59096       8       0      60      60      60      60
GR     374       0     370      18     368      21   366.8      26   366.8      40
GR     368      52     370      60     374      83
X1   59396       7      32     128     280     250     300
GR     380       0     374      32     370      55   368.2      83     370     107
GR     378     128     380     138
X1   59796       7       0      74     350     400     400
GR     390       0     380      20     378      47   377.4      54     378      58
GR     380      70     384      74
X1   60396       7       8     101     560     600     600
GR     392       0     390       8     380      50   379.6      60     380      70
GR     390     101     394     122
X1   60896       9      50     102     500     500     500
GR     398       0     396      50     390      68     388      79   386.5      88
GR     388      90     390      94     400     102     404     122
X1   61396       6       0      66     500     500     500
GR     410       0     400      28     394      40     394      49     400      66
GR     404     102
X1   61696       7       0     118     300     300     300
GR     410       0     400      32     398      36     398      46     400      52
GR     402      84     410     118
X1   62096       7       0     114     350     300     400
GR     410       0     408      14     406      58     404      86     404      92
GR     406     106     410     114
X1   62596       7       0      58     400     550     500
GR     420       0     414      12     412      26     411      34     412      44
GR     416      48     420      58
X1   62662       8      25      45      50      80      66
X3      10
GR423.33       0  425.16      25   416.2      25   412.6      32   412.2      39
GR416.90      45  426.01      45  428.78      60
X1   62690       6      25      45      28      28      28
X3      10
GR423.94       0  425.16      25     413      25   415.5      45  426.29      45
GR429.06      70
X1   62796       8      20      76     106      75     106
GR     440       0     430      20     420      40     418      44     416      48
GR     420      54     430      76     440     106
QT       3             830     440
X1   63396       6      30      54     600     600     600
GR     450      14     440      30     432      44     432      50     440      54
GR     450      66
X1   63596       9      25      73     200     200     200
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x3    10
GR461.13       0  459.36      25   452.5      28   433.7      44   435.1      70
GR446.10      71  446.80      73  457.13      73   456.6      98
x1 63620      10      25      71      24      24      24
x3    10
GR460.88       0  459.46      25   447.4      25   434.1      32   434.3      48
GR 439.5      58   442.1   58.50   451.4      71  456.92      71  457.23      96
x1 63696       7      34      96      76      76      76
GR   460       0     450      34     440      60     436      70     436      74
GR   440      84     450      96
QT     3             744     400
x1 63996       6      22      62     300     300     300
GR   460       0     450      22     442      46     442      52     450      62
GR   460      78
x1 64596       6       0      46     600     600     600
GR   470       0     460      24     454      28     454      32     460      38
GR   470      46
x1 65196       6       0     160     600     600     600
GR   480       0     470      76     466      90     466     110     470     130
GR   480     160
x1 65796       6       0      80     600     600     600
GR   490       0     480      20     476      38     476      54     480      62
GR   490      80
x1 66096       7      54     136     300     300     300
GR   492       0     490      54     486      84   484.5     100     486     108
GR   490     122     494     136
x1 66216       6       0      90     130     100     120
GR   498       0     490      42     488      44     488      50     490      54
GR   496      90
SB   1.0     1.5     3.0       0       4       0   12.57       0       0       0
x1 66246       7      60     150      30      30      30
x2                     1     492     494
BT     5       0     500       0      62     498       0     148     494       0
BT   170     498       0     204     500       0
GR   500       0     498      60     490      88     488      92     488      96
GR   490     100     500     150
x1 66396       6       0     104     150     150     150
GR   506       0     500      22     494      46     494      52     500      70
GR   510     104
x1 66796       5       0      56     420     340     400
GR   520       0     504      16     504      34     510      50     520      56
x1 66850       9      28    83.5      54      54      54
GR 524.4       0   523.9   10.50   516.3      28   511.5      28     503      45
GR 504.2      60   521.8   83.50   523.5      90   525.8     110
x1 66865       7    43.5      67      15      15      15
GR   525       0   524.1      10   511.4   43.50   503.7    43.5   503.8   59.50
GR 514.1      67   523.7      90
x1 66996       6      12     120     131     131     131
GR   530       0     520      12     510      70   508.5      84     510      94
GR   520     120
x1 67396       7       0     160     400     400     400
GR   530       0     520      90     518     104     516     112     516     122
GR   520     140     530     160
x1 67796       6       0     124     400     400     400
GR   540       0     530      52     524      58     524      64     530      78
GR   540     124
x1 68396       6      34      96     600     600     600
GR   552       0     550      34     544      64     542      68     544      76
GR   550      96
x1 68696       7      76     160     300     300     300
GR   566       0     560      76     554      86     552      94     550      98
GR   550     117     560     160
x1 69196       6      42     132     500     500     500
GR   570       0     568      42     558      56     558      66     560      84
GR   570     132
x1 69496       6       0      46     300     300     300
GR   570       0     562      26     562      33     570      46     580      70
GR   590     120
x1 69696       6       0      60     200     200     200
GR   576       0     570      18     566      22     566      26     570      28
GR   580      60
EJ


ER
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1987

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C
C      8
C  53256JUST UPSTREAM OF PROSPECT ROAD/HWY 9 CULVERT
C  53256START BYPASS CHANNEL
C  54302END BYPASS CHANNEL
C  54835PROSPECT CREEK
C  54923D/S SPRR
C  54961U/S SPRR TRACKS
C  57200D\S WARDELL
C  57235U\S WARDELL
T1  CURRENT CONDITION RUN : U/S OF PROSPECT ROAD/HWY 9 TO D/S OF COMER DRIVE
T2  STARTING WATER SURFACE FROM PREV. RUN;DESIGN FLOWRATES FROM THE GREEN BOOK
T3        CALABAZAS CREEK         100-YEAR PROFILE    LAST UPDATE:12/91   SMW
J1             2                                                  306.43
J2     1       0      -1                              -1
J5   -10     -10
QT     2    1800     880
NC  .045    .055    .070      .3      .5
X1 53256      13     990    1010
GR   306     900   304.9     984   304.1     989   305.4     990   294.8     992
GR   294     994     294    1000     294    1004   295.2    1007   304.2    1010
GR 304.9    1018   304.8    1023   304.8    1200       0       0       0       0
X1 53308      20     956    1019      52      52      52
GR   306   896.3   305.6   904.6   306.3   918.8   306.4     956   305.1   960.4
GR 304.9   963.6   305.5   966.4   305.5   971.3   303.6   972.5   296.7   980.7
GR 296.7   988.6   295.6   992.3   295.6    1000   296.2  1003.6   301.6  1011.6
GR 302.7    1019   302.7  1030.2   303.2  1047.1   303.6  1055.2   304.6  1091.6
X1 53357      27   978.4  1015.4      49      49     49.
GR   307     865   307.1   868.2   307.4   868.2     308   893.1   307.6   905.4
GR 306.2   921.8   306.2   931.3   307.3   941.4   307.6   947.3   306.5   978.4
GR 295.6   990.5   295.6    1000   295.6  1005.9   303.2  1015.4   303.5  1020.8
GR 303.1  1033.1     303  1044.2   303.4    1068   304.7  1117.3   305.9  1139.1
GR 306.2    1154   306.2  1174.8   306.1  1195.7   306.6  1206.4   306.9  1221.9
GR 306.6  1245.9   307.2    1280       0       0       0       0       0       0
X1 53453      32   904.1    1160      96      96      96
GR 309.5     840   309.5   842.5   308.7   847.7   309.1   901.4   309.1   904.1
GR 304.2   925.2   301.5   936.4   301.3   942.3   298.8   947.3   298.8   950.9
GR 301.4     954   302.5   969.8   301.6   990.2   297.1    1000   297.1  1008.4
GR 299.3  1013.7   304.1  1021.4     305  1033.3   305.3  1050.6   305.6  1067.4
GR   305  1080.6   304.3  1103.1   304.3  1115.1   304.5  1125.9   305.8  1144.4
GR 306.8    1160   306.8  1172.2     307  1210.5   307.1  1224.6   306.5  1231.3
GR 306.6  1244.8   307.1    1260       0       0       0       0       0       0
X1 53563      23   982.9  1026.8     110     110     110
GR 308.8     880   308.9   882.4   308.9   891.9   303.4   912.9   302.2   920.8
GR 302.2   924.8     303   935.3   308.9   962.7   308.7   982.9   301.6   990.4
GR 297.9    1000   296.9  1004.6   296.9  1013.7   305.4  1026.8   304.7  1041.1
GR 304.9  1051.6   305.8  1068.7   306.1  1097.7   307.7  1135.2   307.9    1154
GR 307.9  1168.1   311.8  1172.3   311.8    1180       0       0       0       0
X1 53675      18   904.2  1075.3     112     112     112
GR 309.2     885   309.3   895.5   309.3   904.2   304.6   923.3   302.5   929.8
GR 302.5   933.3   303.4   936.3     304   952.2     305   969.9   304.4   990.8
GR 298.5   997.7   298.5    1000   298.5  1015.7     305    1031   305.7  1068.4
GR 310.9  1075.3   310.8  1087.7   310.1    1145       0       0       0       0
X1 53750      21   981.8  1042.9      75      75     75.
GR 311.9     885   311.9   904.6   309.2   907.2   309.2   911.7   304.1   928.2
GR 303.8   934.5     304   937.7   308.4   956.9     308   981.8   300.4   990.1
GR 300.4   994.9   299.5   997.4   299.5    1000   299.6  1003.9   300.5  1006.4
GR 300.5  1014.5   305.3  1026.9   305.8  1042.6   310.6  1042.9   310.7  1121.3
GR   310    1145       0       0       0       0       0       0       0       0
X1 53826      19   897.2  1053.9      76      76      76
GR 311.6     860   310.1   897.2   306.2   910.5   305.9   914.7   305.4   923.4
GR 309.2   942.4   308.6   969.9   307.7   981.2   302.5     993   300.8   997.3
GR 300.7    1000   300.7  1003.3   301.3  1006.3   301.3  1015.1   307.7  1030.8
GR 309.4  1043.9   309.9  1053.9   310.9  1132.8   310.4    1140       0       0
X1 53910      24     967  1051.9      84      84      84
GR 311.6     860   311.5   884.3   310.6   893.1   306.8   905.6   306.3   909.9
GR 306.5   918.2   309.8   932.2   310.8   937.9   310.9   940.9   310.4   961.6
GR   310     967   306.2   981.6   301.5   995.1   301.5    1000   301.5  1006.3
GR   301  1009.1     301  1012.3   303.6  1014.4   306.2  1022.2   307.6  1023.4
GR 308.6  1027.4   309.2  1037.9   309.6  1051.9   309.3    1095       0       0
X1 53994      19   978.3  1035.1      84      84      84
GR 312.4     860   311.8   898.7   311.2   902.7   306.7   922.3   306.7   932.5
GR 310.9     953   310.5   978.3   308.9   982.9   302.9   988.5   302.4   997.7
GR   302    1000     302  1009.3   303.6  1016.8   303.8  1021.5   309.9  1035.1
GR 310.7  1055.5   310.9  1082.8     311  1153.8   310.8    1155       0       0
X1 54104      24   963.3    1021     110     110     110
GR 313.8     860     314   861.1   313.7   905.9   312.9   913.8   307.5   928.5
GR 307.8   943.5   310.3   954.9   310.2   963.3     308   977.2   306.5   986.8
GR 302.4   997.3   302.4    1000   302.5  1008.2   303.4  1016.8   311.4    1021
GR 311.4  1026.4   311.3  1038.9   310.8  1046.6   310.8  1058.9   311.5  1067.5
GR 311.8  1081.3   311.6  1113.6   311.3  1152.7   311.3    1155       0       0
X1 54227      16   980.9  1036.9     123     123     123
GR 315.4   888.6     315     904   308.2   929.3   308.4   936.5   313.9   956.4
GR   313   980.9   302.8   993.1   302.8    1000   302.8  1004.4   303.9  1010.1
GR 305.1    1015   311.9  1030.3   312.2  1036.9   311.8  1048.2   311.7    1072
GR   311    1155       0       0       0       0       0       0       0       0
X1 54302     .24   984.5  1033.3      75      75      75
GR 315.2     810   315.2   859.4     315   881.9   310.7   900.2   309.8   910.1
GR 309.3   918.2   308.8   919.3   309.3   924.9   314.3   943.6   313.8   966.2
GR 315.2   972.6   314.6   984.5   304.4   991.5   304.4    1000   304.4  1008.6
GR 309.4  1017.3   312.9  1023.4     314  1033.3   313.3  1043.3   312.3    1049
GR 312.3  1070.4     311  1078.6   311.3  1139.4   311.4    1155       0       0
X1 54451      22   979.9  1023.3     149     149     149
GR 315.4     820   315.2   846.3     315   869.9   312.7   881.4   309.7   889.2
GR   310     896   310.6   900.5   311.6   909.1   311.6   912.2   310.4   928.5
GR 310.7     956   313.6   979.9   307.8     992   306.8    1000   306.8  1011.5
GR 310.5  1018.6   315.9  1023.3   315.9  1032.7   315.1  1041.9   315.4  1053.5
GR 316.6  1067.7   316.6    1080       0       0       0       0       0       0
X1 54598      19   972.9  1012.5     147     147     147
GR 315.4     820   315.5   842.5   315.5   869.8   313.4     883   310.5     894
GR 310.5   903.1   313.4   917.1   315.2   931.3   315.2   955.3   314.7   972.9
GR 308.2   977.3   307.8   979.1     308     993     309    1000   313.5  1003.2
GR 317.3  1012.5     317  1018.9   316.9  1036.2   316.8  1060.4       0       0
X1 54746      23   987.3  1061.8     148     148     148
GR 315.9     815   315.9   883.2   315.1   886.9   315.1   891.1   314.2   896.7
GR 314.2   900.9   315.3   920.3   314.8   926.2   312.7   934.9   311.3   943.4
GR 311.1   962.4     316   987.3   315.6   994.3   309.3    1000   309.3  1040.3
GR 314.4  1053.3   315.8  1061.8   316.2  1107.5   317.6  1118.4   320.4  1132.5
GR 321.3  1137.9   321.8  1143.8   321.8    1145       0       0       0       0
QT     2    1200     580
X1 54835      20   971.8  1059.6      89      89      89
GR 316.9   909.1   316.8   937.9   316.4   955.9   316.3   961.6   317.2     967
GR 317.5   971.8     317     979     316   984.4   315.3   987.1   309.9   987.8
GR 309.9    1000   309.9  1004.1   310.4  1008.3   313.4  1017.9   315.6  1032.4
GR 317.4  1059.6   316.5  1092.9     317  1119.1   321.7  1138.2     322    1145
NC                  .015
X1 54923      16   985.1  1011.9      88      88      88
X3    10
GR 319.4     890   319.4   892.6     319   916.8   318.7   981.7   319.9   985.1
GR   320   989.4   318.4   989.5   318.4   993.3   311.4   996.3   311.4    1000
GR 311.4  1006.3   319.3  1007.7   319.3  1011.2   320.2  1011.9   321.6    1136
GR 322.1    1190       0       0       0       0       0       0       0       0
SB  1.25    1.25      .8       0      12       0      72       0
X1 54961      18    4993    5010      38      38     38.
X2     0       0       1   317.5     320
BT    18    4890     319     319    4900  319.13   318.4    4931  319.44   318.1
BT  4940  319.47   318.1    4955  319.56   318.2    4972  319.76   318.1    4979
BT 319.8   318.4    4993   320.0   319.2    4996  320.01  317.52    5000  320.07
BT 317.5    5008  320.12  317.47    5010  320.17   319.4    5030  320.37   319.6
BT  5058  320.49   319.9    5072   320.6   320.2    5083   320.7   320.2    5151
BT320.85   320.2    5190   321.0   320.2
GR   319    4890   318.9    4900   318.4    4931   318.1    4940   318.2    4955
GR 318.1    4972   318.4    4979   319.2    4993   311.9    4996   311.9    5000
GR   312    5008   319.4    5010   319.6    5030   319.9    5058   320.2    5072
GR 320.2    5083   320.2    5151   320.2    5190       0       0       0       0
X1 54970      18   993.4  1010.4       9       9       9
X3    10
GR   319     790   318.9   901.7   318.4     931   318.1   940.9   318.2   955.5
GR 318.1   972.7   318.4   979.9   319.2   993.4   311.9   996.1   311.9    1000
GR   312  1008.2   319.4  1010.4   319.6  1030.7   319.9  1058.9   320.2  1072.2
GR 320.8  1083.5     321  1151.7   321.5    1190       0       0       0       0
NC                  .070
X1 55041      23   957.1  1023.2      71      71      71
GR 319.1     905   318.7   915.9   318.7   919.3   319.2     940   319.4   944.5
GR 319.5   957.1   317.8   965.9   317.8   977.6   313.4   986.5   313.3   988.9
GR 312.7     990   312.7   991.9   313.4   994.1   313.4    1000   313.5  1003.3
GR 319.4  1012.9   320.2  1023.2     320  1037.2   319.6  1064.2   320.7  1074.4
GR 320.5  1105.9   319.7  1117.1   319.7    1120       0       0       0       0
X1 55135      29   974.7  1009.2      94      94     94.
GR 319.5     880   319.7     880   319.9   885.1   320.1   890.1   320.3   894.8
GR 320.2   900.2     320   905.7   320.1   949.8   320.1   958.7   320.4     963
GR 320.5   974.7   318.2   981.1   314.2   987.5   314.2   989.3   313.5   990.7
GR 313.5   992.8   313.7   994.6   313.9   996.4   313.5   998.4   313.6    1000
GR 313.6  1001.7   322.4  1009.2     323  1014.9     323  1023.8     322  1025.7
GR   322  1028.7   322.6  1040.4   322.8  1076.7   322.8    1120       0       0
X1 55235      15   982.7    1033     100     100    100.
X3    10
GR 320.8     880   320.8   927.7   321.3   960.7   321.7   982.7   314.8   994.8
GR   314.8    1000   314.8  1002.8   314.5  1004.9   314.5    1018   321.4    1033
GR   321.5  1042.1     322  1065.6   322.8  1074.9   322.5  1085.1   322.5    1120
X1   55335      17   979.6    1056     100     100    100.
X3      10
GR   320.1     880   320.2     880   320.2   910.1   320.6   910.5   322.5   964.3
GR   324.1   966.1   323.5   979.6   314.7     991   314.7    1000   314.7    1010
GR   320.4  1012.6   321.4  1020.9   321.2  1037.6   322.2  1044.4   322.7  1053.7
GR   323.5    1056     324    1120       0       0       0       0       0       0
X1   55435      14   983.8  1061.2     100     100    100.
X3      10
GR   321.9     880   322.6   967.3     324   969.4   324.4   983.8   315.7   991.9
GR   315.7    1000   315.7  1009.3   321.2  1014.2   321.2  1022.3   323.6  1046.5
GR   324.6  1061.2   324.9  1104.6   324.3  1119.4   324.3    1120       0       0
X1   55535      21   985.3  1032.2     100     100    100.
X3      10
GR   321.9     890   322.1   931.3   322.7   944.5   322.9   970.4   324.5   976.6
GR   324.4   985.3   323.5   988.9   317.2   995.3   316.7   998.1   316.1    1000
GR   316.1  1007.5   316.4  1010.4   316.4  1012.6   323.5  1020.5     324  1028.3
GR   324.4  1032.2   324.6  1050.2   324.4  1051.3   324.4  1059.9   325.1  1077.9
GR   325.1    1100       0       0       0       0       0       0       0       0
X1   55638      17   974.8    1020     103     103    103.
X3      10
GR   322.6     890   322.9   941.9   324.2   947.1   324.8   960.1   325.3   967.2
GR   325.3   974.8   319.1   977.7   317.3   985.8   316.9   992.9   316.9    1000
GR   316.9  1005.4   323.8  1010.4   324.2    1020   324.5    1047   325.7  1056.5
GR   325.6  1085.5   325.6    1100       0       0       0       0       0       0
X1   55736      17   963.4  1020.8      98      98      98
X3      10
GR   324.6     890   325.3   918.2   324.9   939.6   324.9   952.1   326.3   953.3
GR   326.8   963.4     318   972.3     318   982.1   322.9    1000   325.5  1003.2
GR   325.4  1005.8     325  1007.5   325.2  1018.2   327.3  1020.8   327.4    1063
GR   327.2  1080.7   327.1    1100       0       0       0       0       0       0
X1   55836      12   966.5  1020.4     100     100    100.
X3      10
GR     325     890   326.1   921.8   326.4     956   327.4   960.5   327.9   966.5
GR   318.5   976.8   318.3   989.5   324.9    1000   326.8  1006.4   326.9  1015.3
GR   327.4  1020.4   327.9    1100       0       0       0       0       0       0
X1   55935      13   967.9  1005.2      99      99      99
X3      10
GR   326.6     890     327   943.3   328.1   945.1   328.4     960   328.6   967.9
GR   319.1   972.6   319.1     986   327.5   995.1   328.4    1000   329.2  1005.2
GR   329.5  1042.8   329.4  1083.1   329.4    1100       0       0       0       0
X1   56035      15   960.3   996.4     100     100     100
X3      10
GR   327.6     890   327.5   905.2   327.1   913.4   327.5   927.3   327.8   949.3
GR   329.6   955.7   329.7   960.3   319.6   963.9   319.9     984   328.7   996.4
GR   328.7    1000   328.8  1040.7   329.2  1056.5   329.2  1080.2   329.1    1100
X1   56136      12   974.9  1010.6     101     101    101.
X3      10
GR   329.3     890   329.1   962.7   330.8   970.1   330.5   974.9   320.4   986.7
GR   320.3   995.9   321.4    1000   328.2  1006.4   329.4  1010.6   330.5  1050.8
GR   331.6  1078.6   331.4    1100       0       0       0       0       0       0
X1   56236      16     985  1019.8     100     100    100.
X3      10
GR   330.4   880.3   330.4   902.9   330.4   928.1   329.7   975.9   330.1   979.7
GR   330.2     985   322.4   992.9   322.4    1000   322.4  1005.6     331  1019.8
GR   331.1  1032.5   331.8  1055.3   332.2  1055.3   332.2  1094.7     332  1109.9
GR     332  1130.7       0       0       0       0       0       0       0       0
X1   56330      15   990.9  1032.8      94      94      94
X3      10
GR   330.9   894.9   331.3   907.5   331.4   960.7   332.1   962.8   332.2   990.9
GR   323.4   995.1   323.4    1000   323.4  1007.7   332.6  1027.8     333  1032.8
GR   333.4  1078.4   332.9  1089.5   333.1  1115.6   332.9  1145.6   333.5  1151.8
X1   56402      15   989.6  1035.4      72      72     72.
GR   332.3     901   332.6   957.9   332.5   980.6   332.6   983.5   332.7   989.6
GR   325.3    1000   323.8  1004.9   323.8  1013.8   332.2  1023.8   333.1  1035.4
GR   333.1  1053.3   333.1  1077.4   333.4    1087   334.3  1088.8   334.3  1131.5
X1   56432      18   991.8  1037.2      30      30     30.
X3      10
GR   329.7   849.3   329.6   858.2   331.4   892.3   332.5   914.2   332.7   947.8
GR   332.6   991.8   326.8    1000   323.9  1003.6   323.9  1011.2   324.3  1016.7
GR   332.2    1023   333.1    1030   333.7  1037.2   333.3  1053.9   333.1  1082.6
GR   333.6  1104.9   334.1  1137.9   334.3  1154.9       0       0       0       0
X1   56530      13   985.8  1023.2      98      98     98.
X3      10
GR   331.6   851.6   332.5     880   333.2     909   333.3   930.3   333.2   968.3
GR   333.5   985.8   325.7   993.2   325.7    1000   325.7  1009.6   333.9  1023.2
GR   334.6  1072.1   335.4  1082.3   335.6    1175       0       0       0       0
X1   56604      15   974.8  1045.1      74      74     74.
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x3    10
GR 332.7   822.2   332.7   842.1   333.9     863   334.3   886.3   335.1   930.8
GR 334.8   974.8   325.5   986.8   325.5   993.1     326    1000   334.9  1016.4
GR 335.9  1045.1   336.3  1091.9   336.3  1143.2   336.1  1152.5   336.6    1175
x1 56630      14   973.6  1015.9      26      22     26.
x3    10
GR   333   829.8   332.9   839.7   334.1   864.1     335   887.7   335.2     958
GR 334.9     965   335.2   973.6     326   981.1     326    1000   335.4  1015.9
GR   336    1056   337.1  1074.5   337.4  1154.7   337.4  1154.7       0       0
x1 56730      12   971.9  1023.1     100     100    100.
GR   335     820     335   830.3   336.7   872.5   336.5   971.9   326.9   981.1
GR 326.4   987.8   326.4    1000   326.4  1009.3   339.7  1023.1   339.5  1083.6
GR 339.7  1156.9   339.4    1175       0       0       0       0       0       0
x1 56805      17     976    1014      75      75     75.
GR 335.9     820   335.8   821.2   336.3   823.3   336.3   831.2   337.4   850.4
GR 337.9   962.1   337.9     976   327.6   983.6   327.6    1000   327.3  1001.9
GR 339.1    1014   339.8  1041.3   339.5  1057.4   339.8  1090.7   341.2  1113.5
GR 341.2  1147.8   341.5    1180       0       0       0       0       0       0
x1 57004      12   970.8  1009.6     199     199     199
GR 341.4     885   341.5   962.3   340.9   970.8     329     986     329    1000
GR 340.4  1009.6   340.4  1030.7     341  1081.6   342.2  1089.1   343.3  1110.9
GR 343.3  1144.3   343.6    1150       0       0       0       0       0       0
x1 57104      13   975.6  1013.6     100     100    100.
GR   343     885   342.5   930.8   341.8   948.1   341.6   975.6   329.8     986
GR 329.8    1000   341.3  1013.6   341.6  1037.8   342.4  1058.4   341.9  1066.7
GR   342  1094.6   342.4  1107.1   343.7    1150       0       0       0       0
x1 57155      12   963.9  1024.4      51      51      51
GR 345.2     885   344.8   919.7     343   963.9   342.4   968.7   330.4     980
GR 330.4    1000     340  1006.3   340.5  1012.7   342.5  1024.4   342.8  1080.3
GR 343.1  1141.3   343.1    1150       0       0       0       0       0       0
x1 57200      13   971.3    1022      45      45      45
GR   346     850   346.1   852.3   343.8   971.3   331.8   988.4   331.8    1000
GR 331.8    1007   343.3    1022   343.5  1036.6   343.2  1087.2   343.2    1128
GR 343.1  1138.5   343.5  1201.4   343.9    1230       0       0       0       0
x1 57235      13   989.5  1014.6      35      35      35
GR 346.2     845     346   851.4   345.3     902     345   965.6   345.5   989.5
GR 332.8   992.3   332.8    1000   332.8  1005.8   345.6  1014.6   344.4  1029.3
GR 343.7  1100.1   343.7  1162.7   344.2    1230       0       0       0       0
x1 57306      17   977.2  1025.4      71      71      71
GR 348.4     915     348     937   347.7     952   347.1   956.5   346.3   969.9
GR 346.2   977.2   334.1     991   334.1    1000   334.1  1006.8   344.9  1025.4
GR 344.9  1033.6   344.1  1039.6   344.1  1048.9   344.5  1054.7   344.6  1066.8
GR 343.7  1072.8   343.6    1100       0       0       0       0       0       0
x1 57509      18   992.5  1049.1     203     203     203
GR 357.6     890   357.5   926.9   357.4   962.8   355.6   969.5   354.5   981.3
GR 350.6   983.9     350   992.5   346.2    1000   336.3    1014   336.3  1031.6
GR 346.4  1049.1   346.4  1079.1   346.5  1131.9   346.8  1169.7   348.1  1172.3
GR 348.1  1183.5   347.6  1184.9   347.6    1195       0       0       0       0
x1 57718      16     987  1054.7     209     209     209
GR 362.2     890   360.8   967.1   358.4   976.9   354.2   979.9     354     987
GR 344.9    1000   339.1  1009.8   339.3  1025.5   339.8  1033.1   343.9  1039.2
GR 346.2  1044.3     350  1054.7     350  1086.7   349.5  1143.1   349.5  1193.4
GR 349.2    1195       0       0       0       0       0       0       0       0
x1 57918      13   966.4  1054.5     200     200    200.
GR 355.8     890   355.8   939.7   354.9   966.4   340.6   982.3   340.6    1000
GR 340.6  1008.2   346.8  1012.5   346.8  1036.8   351.9  1052.5   353.1  1054.5
GR 353.1  1059.5   353.1  1100.8   353.1    1110       0       0       0       0
x1 58039      10     946  1010.4     121     121     121
GR 355.6     890   355.9   899.1   355.9   927.1   354.9     946   341.9   961.7
GR   342     982   352.6    1000     355  1010.4   355.6    1110   355.6    1110
x1 58149      12   920.5   994.3     110     110    110.
GR 356.3     905   356.1   920.5   342.6   949.3   342.5   967.3     360   994.3
GR   360    1000   360.4  1006.6   360.4  1033.6   359.7    1050   359.7  1068.1
GR   360  1101.3     360    1110       0       0       0       0       0       0
x1 58334      10   941.1  1018.9     185     185    185.
GR 357.3     905   357.5   941.1   343.8   971.4   343.8   989.3   350.2    1000
GR 360.6  1018.9   361.9  1041.4   362.2  1060.2   362.2    1095   362.2  1100.7
x1 58505      19   941.8  1022.6     171     171    171.
GR 359.6     905   359.8   905.1     360   941.8   359.4   951.9   358.3   956.8
GR 350.1   984.2   345.6   986.1   345.1   992.9   345.1    1000   345.1  1004.5
GR 364.9  1022.6   364.5  1024.7   364.7  1038.5     365  1058.1   366.8  1058.1
GR   367  1065.7     370  1069.3     370    1095   370.3    1145       0       0
EJ
T1  CURRENT CONDITION RUN : U/S OF PROSPECT ROAD/HWY 9 TO D/S OF COMER DRIVE
T2  STARTING WATER SURFACE FROM PREV. RUN;DESIGN FLOWRATES FROM THE GREEN BOOK
T3       CALABAZAS CREEK         10-YEAR PROFILE      LAST UPDATE:12/91   SMW
J1             3                                                  299.68
J2    15       0      -1                              -1
```

# Appendix B

## THOMAS REID ASSOCIATES LETTER REPORTS

THOMAS REID ASSOCIATES
560 WAVERLEY ST., SUITE 201 (BOX 880), PALO ALTO, CA 94301
Tel: 650-327-0429 Fax: 650-327-4024 tra@igc.org

JUL 6 2001

July 5, 2001

Mark Minkowski
Kennedy/Jenks Consultants
2191 E. Bayshore Rd., Suite 200
Palo Alto CA 94303

Re: Santa Clara Valley Water District, Comer Debris Basin Feasibility Study
Field Visit June 28, 2001

Dear Mark:

On June 28, 2001 a field visit was conducted at the Comer Debris Basin on Calabazas Creek in the City of Saratoga. Liang Lee and Liang Xu from the Santa Clara Valley Water District were present as were Mark Minkowski from Kennedy/Jenks and Janet Cochrane from Thomas Reid Associates. The purpose of the field visit was to discuss the benefits and constraints of removing or modifying the debris basin and associated sediment buildup and to discuss potential environmental impacts and benefits associated with the alternatives. Kennedy/Jenks will be preparing the list of alternatives discussed in the field as part of the Comer Debris Basin Feasibility Study.

The purpose of this letter is to summarize the major environmental issues associated with any changes that may be proposed by the Feasibility Study. These issues would need to be further researched in an appropriate CEQA document. A handwritten Initial Study checklist is attached that highlights potential issues that would need to be addressed in a CEQA document. This checklist is not exhaustive, other issues could arise during the preparation of the Feasibility Study that would need to be addressed.

I highly recommend that a qualified biologist visit the site to determine potential biological impacts and benefits associated with each of the proposed alternatives. The creek corridor appears to contain high quality riparian habitat that supports many plant and animal species, including possibly special status species. There is also a potential for wetlands at the base of the debris basin. In addition, the U.S. Army Corps of Engineers will need to be consulted if the creek is deemed "waters of the U.S."

*Conservation Planning and Implementation* ☐ *Environmental Impact Analysis*
*Geographic Information Systems* ☐ *Wetland Delineation* ☐ *Biological Surveys*

The major environmental issues are summarized below:

Aesthetics: potential impacts if any trees removed (the oak behind the sidewall probably won't be affected if the sidewall remains). Equipment would need to be operated carefully to avoid impacts to existing trees. Aesthetics could be improved if channel restored to a more a natural state, especially if more riparian vegetation is planted in the widened area behind the basin.

Air Quality: could have temporary air quality impacts due to truck trips and emissions from equipment used to remove headwall and sediment. There will also be dust if headwall is demolished.

Biology: potential presence of special status species (a Cooper's Hawk was spotted which is a California Species of Special Concern). What is the effect of the alternatives on biological values of the creek? Are there potential wetlands at the base of the debris basin that would be disturbed by any of the alternatives?

Water Quality: effects on water quality if more or less sediment is released downstream

Cultural Resources: potential impacts to cultural resources if native, previously undisturbed soil is disturbed/excavated

Geology/Soils: could changes cause any soil/bank instability anywhere along the creek?

Hazardous Materials: is there a potential for the sediment to contain any hazardous materials that could be release during removal?

Hydrology: could changes cause flooding downstream? What are the changes to the overall hydrology of the creek?

Noise: there will be temporary construction noise with any type of work due to truck trips and use of heavy equipment for sediment removal and if the headwall is demolished

Traffic: there will be temporary traffic impacts associated with increased truck and equipment trips

Please feel free to call me with any questions. I can be reached at 650-327-0429 x72 or by e-mail at cochrane@traenviro.com.

Yours truly,

Janet Cochrane

Janet Cochrane

attach

## Environmental Checklist Form

1. Project title: Comer Debris Basin - Calabazas Creek

2. Lead agency name and address:
Santa Clara Valley Water District

3. Contact person and phone number:

4. Project location: City of Saratoga

5. Project sponsor's name and address:
Santa Clara Valley Water District

6. General plan designation:

7. Zoning:

8. Description of project: (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation. Attach additional sheets if necessary.)
potential removal or modification to debris basin and sediment removal

9. Surrounding land uses and setting: Briefly describe the project's surroundings:
residential

10. Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.)

Comer Debris Basin - Calabazas Creek June 28, 2001

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **I. AESTHETICS** -- Would the project: | | | | |
| a) Have a substantial adverse effect on a scenic vista? | ☐ | ☐ | ☐ | ☐ |
| b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway? | ☐ | ☐ | ☐ | ☐ |
| c) Substantially degrade the existing visual character or quality of the site and its surroundings? | ☐ | ☐ | ☐ | ☐ |
| d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area? | ☐ | ☐ | ☐ | ☐ |

Aesthetic
Improvement if riparian vegetation restored

Tree Removal? - could impact aesthetics

|  | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **II. AGRICULTURE RESOURCES --** In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project: |  |  |  |  |
| a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use? | ☐ | ☐ | ☐ | ☐ |
| b) Conflict with existing zoning for agricultural use, or a Williamson Act contract? | ☐ | ☐ | ☐ | ☐ |
| c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use? | ☐ | ☐ | ☐ | ☐ |

N/A

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **III. AIR QUALITY** -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project: | | | | |
| a) Conflict with or obstruct implementation of the applicable air quality plan? | ☐ | ☐ | ☐ | ☐ |
| b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation? | ☐ | ☐ | ☐ | ☐ |
| c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? | ☐ | ☐ | ☐ | ☐ |
| d) Expose sensitive receptors to substantial pollutant concentrations? | ☐ | ☐ | ☐ | ☐ |
| e) Create objectionable odors affecting a substantial number of people? | ☐ | ☐ | ☐ | ☐ |

Temporary Truck / Equipment Emissions from Sediment removal & headwall demolition

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **IV. BIOLOGICAL RESOURCES --** Would the project: | | | | |
| a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service? | ☐ | ☐ | ☐ | ☐ |
| b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service? | ☐ | ☐ | ☐ | ☐ |
| c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means? | ☐ | ☐ | ☐ | ☐ |
| d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites? | ☐ | ☐ | ☐ | ☐ |
| e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance? | ☐ | ☐ | ☐ | ☐ |
| f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan? | ☐ | ☐ | ☐ | ☐ |

Riparian - High quality both u/s and d/s of debris basin

Ponding below headwall for sediment basin (possible wetland and/or Frog or turtle habitat?

water in creek below headwall (seeping from wall & banks)

Oak west of retaining wall - destabilize if walls removed?

potential for benefits if riparian vegetation restored

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **V. CULTURAL RESOURCES --** Would the project: | | | | |
| a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5? | ☐ | ☐ | ☐ | ☐ |
| b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5? | ☐ | ☐ | ☐ | ☐ |
| c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? | ☐ | ☐ | ☐ | ☐ |
| d) Disturb any human remains, including those interred outside of formal cemeteries? | ☐ | ☐ | ☐ | ☐ |

only issue if native soil is disturbed

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **VI. GEOLOGY AND SOILS --** Would the project: | | | | |
| a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: | | | | |
| i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42. | ☐ | ☐ | ☐ | ☐ |
| ii) Strong seismic ground shaking? | ☐ | ☐ | ☐ | ☐ |
| iii) Seismic-related ground failure, including liquefaction? | ☐ | ☐ | ☐ | ☐ |
| iv) Landslides? | ☐ | ☐ | ☐ | ☐ |
| b) Result in substantial soil erosion or the loss of topsoil? | ☐ | ☐ | ☐ | ☐ |
| c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? | ☐ | ☐ | ☐ | ☐ |
| d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property? | ☐ | ☐ | ☐ | ☐ |
| e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water? | ☐ | ☐ | ☐ | ☐ |

Instability caused any changes

|  | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **VII. HAZARDS AND HAZARDOUS MATERIALS** — Would the project: |  |  |  |  |
| a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials? | ☐ | ☐ | ☐ | ☐ |
| b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment? | ☐ | ☐ | ☐ | ☐ |
| c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school? | ☐ | ☐ | ☐ | ☐ |
| d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment? | ☐ | ☐ | ☐ | ☐ |
| e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area? | ☐ | ☐ | ☐ | ☐ |
| f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area? | ☐ | ☐ | ☐ | ☐ |
| g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan? | ☐ | ☐ | ☐ | ☐ |
| h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands? | ☐ | ☐ | ☐ | ☐ |

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Hazardous material in sediment ?

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **VIII. HYDROLOGY AND WATER QUALITY** -- Would the project: | | | | |
| a) Violate any water quality standards or waste discharge requirements? | ☐ | ☐ | ☐ | ☐ |
| b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)? | ☐ | ☐ | ☐ | ☐ |
| c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site? | ☐ | ☐ | ☐ | ☐ |
| d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site? | ☐ | ☐ | ☐ | ☐ |
| e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff? | ☐ | ☐ | ☐ | ☐ |
| f) Otherwise substantially degrade water quality? | ☐ | ☐ | ☐ | ☐ |
| g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map? | ☐ | ☐ | ☐ | ☐ |
| h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows? | ☐ | ☐ | ☐ | ☐ |

Change flooding potential?

Change water quality ?

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam? | ☐ | ☐ | ☐ | ☐ |
| j) Inundation by seiche, tsunami, or mudflow? | ☐ | ☐ | ☐ | ☐ |

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **IX. LAND USE AND PLANNING --** Would the project: | | | | |
| a) Physically divide an established community? | ☐ | ☐ | ☐ | ☐ |
| b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect? | ☐ | ☐ | ☐ | ☐ |
| c) Conflict with any applicable habitat conservation plan or natural community conservation plan? | ☐ | ☐ | ☐ | ☐ |

N/A

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **X. MINERAL RESOURCES** -- Would the project: | | | | |
| a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state? | ☐ | ☐ | ☐ | ☐ |
| b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan? | ☐ | ☐ | ☐ | ☐ |

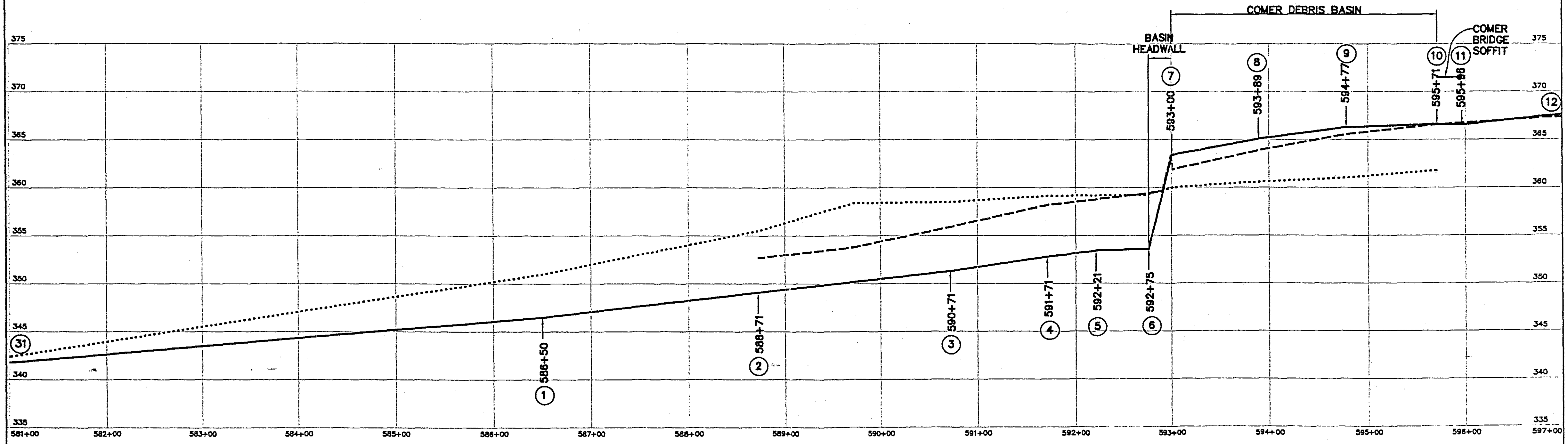
N/A

|  | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XI. NOISE** -- Would the project result in: |  |  |  |  |
| a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies? | ☐ | ☐ | ☐ | ☐ |
| b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels? | ☐ | ☐ | ☐ | ☐ |
| c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project? | ☐ | ☐ | ☐ | ☐ |
| d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project? | ☐ | ☐ | ☐ | ☐ |
| e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? | ☐ | ☐ | ☐ | ☐ |
| f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels? | ☐ | ☐ | ☐ | ☐ |

Temporary noise impacts from construction

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XII. POPULATION AND HOUSING --** Would the project: | | | | |
| a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)? | ☐ | ☐ | ☐ | ☐ |
| b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere? | ☐ | ☐ | ☐ | ☐ |
| c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere? | ☐ | ☐ | ☐ | ☐ |

N/A



0 40 80 HORZ. 1"=50' **PROFILE** 0 4 5 VERT. 1"=5'

- ………………… 1972 (PRE-CONSTRUCTION) – 1987 PROFILE
- – – – – – – – 1974 (FIRST YEAR OF OPERATION)
- ———— 2001
- ⑤ 2001 SCVWD SURVEY SECTION ID

**USE OF DOCUMENTS**

THIS DOCUMENT, INCLUDING THE INCORPORATED DESIGNS, IS AN INSTRUMENT OF SERVICE FOR THIS PROJECT AND SHALL NOT BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF KENNEDY/JENKS CONSULTANTS.

| NO. | REVISION | DATE | BY |
|---|---|---|---|
| | | | |

**SCALES**

0 ——— 1"

0 ——— 25mm

IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

DESIGNED XXX

DRAWN XXX

CHECKED XXX

SANTA CLARA VALLEY WATER DISTRICT
SANTA CLARA COUNTY, CALIFORNIA
COMER DEBRIS BASIN ENGINEERING PRE-PLANNING STUDY

Kennedy/Jenks Consultants
PALO ALTO, CALIFORNIA

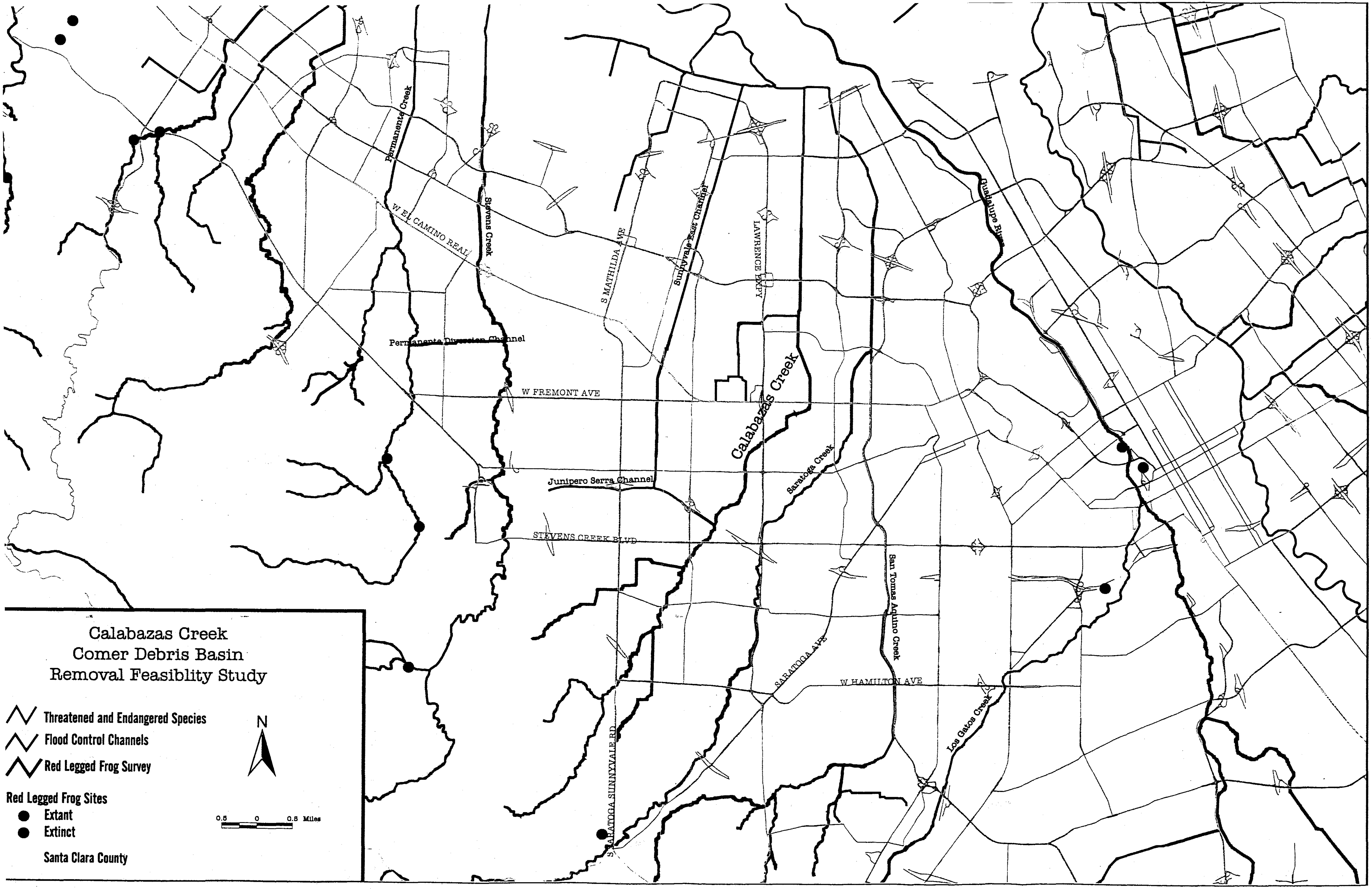
**CHANNEL PROFILES**
HISTORIC SUMMARY

FILE NAME

JOB NO. 015014.00

DATE AUG 2001

SHEET XX OF XX



Calabazas Creek
Comer Debris Basin
Removal Feasiblity Study

|  | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XIII. PUBLIC SERVICES --** |  |  |  |  |
| a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: |  |  |  |  |
| i) Fire protection? | ☐ | ☐ | ☐ | ☐ |
| ii) Police protection? | ☐ | ☐ | ☐ | ☐ |
| iii) Schools? | ☐ | ☐ | ☐ | ☐ |
| iv) Parks? | ☐ | ☐ | ☐ | ☐ |
| v) Other public facilities? | ☐ | ☐ | ☐ | ☐ |

N/A

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XIV. RECREATION --** | | | | |
| a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated? | ☐ | ☐ | ☐ | ☐ |
| b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment? | ☐ | ☐ | ☐ | ☐ |

Improve Recreational value of creek, if able to walk under bridge and walk through debris basin headwall

**XV. TRANSPORTATION/TRAFFIC --**
Would the project:

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)? | ☐ | ☐ | ☐ | ☐ |
| b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways? | ☐ | ☐ | ☐ | ☐ |
| c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks? | ☐ | ☐ | ☐ | ☐ |
| d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)? | ☐ | ☐ | ☐ | ☐ |
| e) Result in inadequate emergency access? | ☐ | ☐ | ☐ | ☐ |
| f) Result in inadequate parking capacity? | ☐ | ☐ | ☐ | ☐ |
| g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)? | ☐ | ☐ | ☐ | ☐ |

Temporary trips from construction vehicles

| | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XVI. UTILITIES AND SERVICE SYSTEMS** -- Would the project: | | | | |
| a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board? | ☐ | ☐ | ☐ | ☐ |
| b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | ☐ | ☐ | ☐ | ☐ |
| c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects? | ☐ | ☐ | ☐ | ☐ |
| d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed? | ☐ | ☐ | ☐ | ☐ |
| e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments? | ☐ | ☐ | ☐ | ☐ |
| f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs? | ☐ | ☐ | ☐ | ☐ |
| g) Comply with federal, state, and local statutes and regulations related to solid waste? | ☐ | ☐ | ☐ | ☐ |

Where does sediment + demolition debris go?

|  | Potentially Significant Impact | Less Than Significant with Mitigation Incorporation | Less Than Significant Impact | No Impact |
|---|---|---|---|---|
| **XVII. MANDATORY FINDINGS OF SIGNIFICANCE --** |  |  |  |  |
| a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | ☐ | ☐ | ☐ | ☐ |
| b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)? | ☐ | ☐ | ☐ | ☐ |
| c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? | ☐ | ☐ | ☐ | ☐ |

**THOMAS REID ASSOCIATES**
560 WAVERLEY STREET, SUITE 201 Tel: 650-327-0429
P.O. BOX 880 PALO ALTO, CA 94301 Fax: 650-327-4024

*Environmental Impact Analysis ● Ecological Studies ● Resource Management*

July 24, 2001

Mark Minkowski
Kennedy/Jenks Consultants
2191 E. Bayshore Rd., Suite 200
Palo Alto CA 94303

Re: Santa Clara Valley Water District, Comer Debris Basin Feasibility Study Field Visit of July 20, 2001

Dear Mr. Minkowski,

The Comer debris basin area on Calabazas Creek was visited on July 20, 2001 by TRA biologists Wendy Knight and Patrick Kobernus. We surveyed 500 feet upstream and downstream of the debris basin. See Table 1 for a list of plants and animals observed on site.

Upstream of Comer Drive, the creek is dominated by arroyo and red willows (*Salix* spp.), California blackberry (*Rubus ursinus*), and poison oak (*Toxicodendron diversilobum*). The creek channel is well shaded and narrow and the stream bed substrate is a mixture of cobbles, gravels and sand. There is no evidence of erosion or bank instability in this stretch. The stream bed was completely dry until upstream of a driveway bridge. There we began to see small pools of standing water approximately 3 inches deep. Pacific chorus frog (*Hyla regilla*) tadpoles were found in the pools.

Downstream of the Comer Drive bridge, the creek bed widens and the banks are low. At the sediment basin wall, there is a 20 foot drop to the original creek bed. The area at the base of the wall has plants characteristic of a wetland such as horsetail (*Equisetum* sp.), willow herb (*Epilobium* sp.), narrow leaf cattail (*Typha angustifolia*), and umbrella sedge (*Cyperus eragrostis*). A jurisdictional wetland delineation would need to be conducted in this area before removing or altering the sediment basin wall. This type of project would require the Nationwide Permit 27 which states that delineations must be prepared before and after any bank stabilization, riffle or pool restoration is done.

Downstream of the wall, stream banks show evidence of erosion and in many places concrete slabs, boulders, or sandbags have been placed in the channel to protect the banks. In addition to arroyo willow, coast live oak (*Quercus agrifolia*), and blue elderberry (*Sambucus mexicana*), there are more exotic species such as English ivy (*Hedera helix*), blue gum (*Eucalyptus globosa*) and Himalayan blackberry (*Rubus discolor*) in this stretch. Three large (3-4' dbh) coast live oaks may be lost if the bank continues to erode downstream from the sediment basin. There are more pools downstream of the sediment basin, but they are not very large or deep, and do not appear to provide a permanent source of water. These pools also contained Pacific chorus frog tadpoles.

Taking out the sediment basin wall would result in several long term benefits to Calabazas Creek, including the following:

1) Restoring the original grade to the creek may improve the flow of water and increase the number of pools during the dry season which would be beneficial to wildlife (chorus frogs, birds, deer, fish).

2) The stream may cause less bank erosion if it is carrying a higher sediment load.

3) For the area just upstream of the sediment basin structure, restoring the debris basin to its natural state by narrowing the channel and replanting with riparian plants would be beneficial to the long-term health of the creek as well as to the birds and other animals that utilize the riparian corridor. These riparian plants could also provide shaded riverine aquatic (SRA) habitat.

4) Removal of a barrier to fish migration.

5) There would be more sand and gravel accumulation downstream of the basin which would improve potential downstream spawning beds for steelhead. This would be important if restoring steelhead to the creek was a long-term goal. While there are currently no steelhead occupying this portion of Calabazas Creek, historically they were present.

The following short-term negative effects could occur as a result of implementing any of the proposed alternatives; these effects could be minimized or mitigated through the CEQA process:

1) If stream velocity is expected to increase, there may be increased water pressure on the already eroding stream banks and three or more large (> 36" dbh) coast live oaks may be lost.

2) Restoring the original grade of the stream could involve removing sediment from the creek for hundreds of meters upstream. This upper portion of the creek currently has a nice balance of cobbles, sand, and gravels and this substrate would be temporarily destroyed until the creek had time to redistribute sediment.

3) When removing sediment from the upper reaches of the creek, heavy machinery could compact and straighten out the creek bed and channel, remove large woody debris, and disturb existing riparian vegetation in and overhanging the creek. It would be imperative to recreate a natural channel and to reduce impacts to overhanging trees and exposed rootwads.

4) Heavy equipment operation in the riparian corridor could disturb nesting raptors. It would be necessary to survey for nesting raptors before beginning any operations in the creek.

A search of the California Natural Diversity Database (CNDDB) revealed that California tiger salamanders and California red-legged frogs have been recorded nearby and may occur in the area. We also considered the habitat requirements of the Western pond turtle, Foothill yellow-legged frog, and raptors. Within the last five years, Calabazas Creek has been surveyed upstream and downstream of the Comer debris basin for amphibians and reptiles and no special status species have been observed (pers. comm. D. Padley, SCVWD).

**California tiger salamander** (*Ambystoma californiense*)
The California tiger salamander (CTS) is a federal candidate species and a California species of special concern. CTS require a complex mixture of habitats, consisting of seasonally filled pools bordering on wooded savannah. The nearest occurrence of CTS is approximately 3.5 miles to the NW of the Comer debris basin (CNDDB 2001). Although there are several small pools in the channel, they are very shallow and lack emergent vegetation. Additionally, upland refugia is not available. Therefore, the surveyed section of creek does not provide habitat for this species.

**California red-legged frog** (*Rana aurora draytonii*)
The California red-legged frog (CRLF) is federally threatened. CRLF typically live in still fresh water such as ponds, lakes, and marshes, or in slow flowing sections of creeks and streams. Populations of CRLF are thought to require permanent or nearly permanent bodies of water for persistence and populations probably cannot be maintained in ephemeral streams in which all surface water disappears. CRLF are known to occur in grassland, riparian woodland, oak woodland, and coniferous forest but prefer quiet pools, slow-flowing streams, and marshes with heavily vegetated shores for breeding. These frogs stay near the shore hidden in vegetation rather than in open water. Seasonal bodies of water are frequently occupied by red-legged frogs, and in some areas these may be critical for persistence. CRLF are thought to disperse widely during autumn, winter, and spring rains. Frogs disperse though many types of upland vegetation and use a broader range of habitats outside of breeding season.

CNDDB records show that CRLF occur 2 miles to the south of the site, and 4 miles to the northwest (2001). There is no breeding habitat for the CRLF in the surveyed section of creek. It is possible that Calabazas could be used as dispersal habitat during years with more flow, however, the pool numbers and depths that we observed during our survey did not seem deep or large enough. Protocol surveys were conducted for the CRLF in May 2001 and 1997 (pers. comm. D. Padley, SCVWD) and no frogs were found.

**Western pond turtle** (*Clemmys marmorata*)
The Western pond turtle is a state and federal species of special concern. Western pond turtles prefer calm waters such as streams or pools with vegetated banks and basking sites such as logs or rocks. When disturbed, they seek cover in water, diving beneath the surface and hiding in vegetation or beneath submerged rocks and debris. Most commonly, eggs are laid in sandy banks adjacent to water. Occasionally, eggs may be laid considerable distances away from water. Western pond turtles hibernate during the winter by submerging themselves in stream-bottom mud. Western pond

turtles normally associate with permanent water sources. At the time of the survey, Calabazas Creek did not appear to provide deep, permanent pools sufficient for pond turtle habitation.

**Foothill yellow legged frogs** (*Rana boylii*)
The foothill yellow-legged frog is a federal and state species of concern. They live in small, sometimes seasonal pools and slow-moving creeks, preferring regions with rocky cover and cobble sized substrate. These frogs spend the majority of their time in or very near water. Adults often bask on exposed rocks, diving into the water and hiding beneath submerged rocks. They are rarely encountered far from permanent water sources, even on rainy nights (Zeiner et al. 1988). Critical habitat should be identified in part by the presence of oviposition habitat having riffle areas with a substrate of cobble-sized or larger rocks (Jennings and Hayes 1994). Oviposition occurs in late March to early June and a minimum of 15 weeks is need to attain metamorphosis, which typically occurs between July and September (Jennings and Hayes 1994). Such habitat is not present in the surveyed area particularly since the creek is currently dry and, with the exception of a few small, shallow ponds, appears to have been dry for several months.

**Raptors**
A juvenile Cooper's hawk (*Accipiter cooperii*) was found in the wetland area at the base of the sediment basin wall by TRA associate Janet Cochrane. Cooper's hawks forage and nest in oak woodland and riparian habitat. Other raptors that could utilize the Calabazas Creek riparian corridor include red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipiter striatus*), Western screech owl (*Otus kennicottii*) and great horned owl (*Bubo virginianus*). These raptors would be negatively impacted by the sediment removal project if heavy equipment operation and loud noise occurred during the nesting season.

If you have any questions, please contact me at (650) 327-0429 x87.

Sincerely,

Wendy Knight

Wendy Knight
Biologist

## References

California Natural Diversity Database. May 2001.

Jennings, M.R., M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game.

Padley, D. Personal communication, July 24, 2001. Santa Clara Valley Water District (SCVWD).

Zeiner, D., W. Laudenslayer, K. Mayer. 1988. California's Wildlife: Reptiles and Amphibians. Vol. 1. Department of Fish and Game.

**Table 1.** Plant and animal species recorded during survey of Comer debris basin.

| **Common name** | **Scientific name** |
|---|---|
| mugwort | *Artemesia douglasiana* |
| giant reed | *Arundo donax* |
| coyotebrush | *Baccharis pilularis* |
| bull thistle | *Cirsium vulgare* |
| virgin's bower | *Clematis ligusticifolia* |
| poison hemlock | *Conium maculatum* |
| umbrella sedge | *Cyperus eragrostis* |
| water grass | *Echinacloa sp.* |
| creeping wild rye grass | *Elymus triticoides* |
| willow herb | *Epilobium* sp. |
| horsetail | *Equisetum* sp. |
| silver dollar eucalyptus | *Eucalyptus* sp. |
| blue gum | *Eucalyptus globosa* |
| sweet fennel | *Foeniculum vulgare* |
| French broom | *Genista monspessulana* |
| cudweed | *Gnaphalium* sp. |
| English ivy | *Hedera helix* |
| sneezeweed | *Helenium* sp. |
| field mustard | *Herschfeldia* |
| toyon | *Heteromeles arbutifolia* |
| Northern California black walnut | *Juglans californica* var. *hindsii* |
| Baltic rush | *Juncus balticus* |
| duckweed | *Lemna minor* |
| Italian wild rye | *Lolium multiflorum* |
| honeysuckle | *Lonicera hispidula* var. *vacillans* |
| sweet clover | *Melilotus alba* |

| | |
|---|---|
| spearmint | *Mentha spicata* |
| sticky monkey flower | *Mimulus aurantiacus* |
| bristly ox tongue | *Picris echioides* |
| Monterey pine | *Pinus radiata* |
| common plantain | *Plantago hirtella* var. *galeottiana* |
| Western sycamore | *Platanus racemosa* |
| rabbitfoot grass | *Polypogon monspeliensis* |
| pyrocantha | *Pyrocantha* sp. |
| coast live oak | *Quercus agrifolia* |
| wild rose | *Rosa californica* |
| California blackberry | *Rubus ursinus* |
| Himalayan blackberry | *Rubus discolor* |
| curly dock | *Rumex crispus* |
| red willow | *Salix laevigata* |
| arroyo willow | *Salix lasiolepis* |
| blue elderberry | *Sambucus mexicana* |
| California bee plant | *Scrophularia californica* |
| nightshade | *Solanum* sp. |
| prickly lettuce | *Sonchus oleraceus* |
| common snowberry | *Symphoricarpos albus* var. *laevigatus* |
| poison oak | *Toxicodendron diversilobum* |
| narrowleaf cattail | *Typha angustifolia* |
| California bay | *Umbellularia californica* |
| stinging nettle | *Urtica dioica* ssp. *gracilis* |
| periwinkle | *Vinca major* |
| cocklebur | *Xanthium strumarium* |
| **Animals** | |
| Stellar's jay | *Cyanocitta stelleri* |
| chestnut back chickadee | *Parus rufescens* |

| | |
|---|---|
| black phoebe | *Sayornis nigricans* |
| American robin | *Turdus migratorius* |
| mourning dove | *Zenaida macroura* |
| blacktail deer | *Odocoileus hemionus* |
| domestic dog | *Canis domesticus* |
| fox squirrel | *Sciurus niger* |
| Pacific chorus frog | *Hyla regilla* |
| western fence lizard | *Sceloporus occidentalis* |
| Lorquin's admiral | *Limenitis lorquini* |
| cabbagewhite butterfly | *Pieris rapae* |
| waterstrider | *Gerris remigis* |

# Appendix C

## PUBLIC WORKSHOP NO. 1 MEETING MINUTES

# Calabazas Comer Debris Basin
# Neighborhood Meeting

Saratoga High School
August 21, 2001 - 7 p.m.

## Meeting Notes

| | |
|---|---|
| District Participants: | Greg Zlotnick, Gerry Unenaka, Imelda Suarez, Beth Redmond, MaryLou Giuffrida, Liang Xu, Liang Lee, Jason Christie, Tim Bramer. |
| Consultant Participants: | Mark Minkowski, Christine Schneider |
| Neighborhood Participants | |

Introduction by Liang Lee, Senior Project Manager. Liang discussed the background and history of the Basin, which was built in 1972/73 to catch sediment at the request of the Cities of Saratoga and San Jose. The basin was maintained by the District between 1973 and 1992. Sediment was removed nine times during this period. Since 1992 the basin was not emptied to stop the downstream degradation.

A power point presentation was shown by Mark Minkowski (Kennedy-Jenks), the District's consultant for the study. He showed how the District was conducting this study to look at the feasibility of removing, modifying, or leaving the basin untouched. Three alternatives were presented.

### Alternatives

No. 1: Do nothing – existing conditions.

No 2: Remove entire headwall, but not wingwalls.

No. 3: Take part of dam out to solve flooding problem at Comer Drive.

### Questions/Comments asked by audience:

**Question**: What would be used to maintain the step effect in Alternative No. 4?

**Answer**: Not determined at this time. Could be boulders. They would have to be engineered to withstand large flows. We would try to keep them looking natural.

**Question/Comment**: Why was maintenance stopped? You should remove the entire structure except the wing walls to protect the oak – leave the gravel and just let the sediment go downstream naturally. It will replenish downstream areas that have eroded after the basin was put in and this would be less expensive. Downstream areas have been starved of sediment causing erosion.

**Comment:** If you take the wall out water will erode my property on the east side. I would like to see a channel/trench. It will help keep it away from my property.

**Comment**: His property had serious erosion on the south side before the basin was built. I will be more affected than anyone else. I would like to see no action at all. I currently have no erosion – leave it alone. Thank you.

**Comment**: We own property on both sides adjacent to the dam. We may lose 40+ feet from the bank and the other side may lose 10+ feet if the dam is removed.

**Comment**: The dam takes an enormous amount of energy when water hits the bank.

**Comment**: How much money has been spent to study the issue? I have asked for 3 years for the District to do maintenance where erosion was occurring in my backyard. We were told that it was not in the budget. Why are we here looking at removing this structure? We have already lost 2 trees – nothing was done. Who sets priorities? (three pictures were provided showing the bank eroding away from the bottom of a tool shed.) We think the whole thing was wrong from the start.

**Answer**: Director Greg Zlotnick responded that the District and the Board set priorities for maintenance. The capital projects are funded separate from the maintenance work that was referred to. The resident asked for and was given a list of addresses for the Board of Directors. Another resident made comments about this individual's attempts at erosion repair.

**Comment**: I feel that the basin has kept my property from flooding – this bank has dropped 6 feet below structure– tree roots are exposed, but that is better than flooding. Has this added to creek capacity? Partial removal seems to make sense. What effect will removing the basin have on flood control? There is a FEMA flood plan from Wardell upstream to the railroad. Sediment will be increased.

**Comment**: You should pay attention to the other bridge on the Wardell. It is small and may be damaged. The dam stops logs, etc. The trapped logs increase the water level and causes flooding.

**Comment**: People throw clippings and bags into the creek. It makes it messy. Debris in the creek is part of the problem – it goes down to the next bridge and creates a dam. Can the District have a program to mail notices to residents along the creek to remind them not to dump into the creek?

**Comment**: Why did the District stop maintaining the debris in the basin? What was the decision process? Does this decrease flood capacity? Will this be looked at in the study?

**Answer**: Liang said that it was noticed after several years of operation that the downstream section up to the railroad was being eroded as a result of the sediment being retained at the basin and the downstream being deprived from its normal supply of sediment. Hence, the maintenance was halted to reverse this trend. It has been reported that the downstream section has grown back a little. As part of the study, we will certainly look at the overall slope, channel cross-sections, and sediment supply to determine the impacts of any and all the alternatives. One of our fundamental objectives is flood protection. Anything we do or don't do, we will make sure that you have flood protection.

**Comment (Greg Zlotnick)**: Talked about the District's responsibility. Whether the District has easement or not, it does not have the responsibility to maintain the creek for the property owners who own the property. Owners can spend their own money to maintain the creek.

**Comment**: Fifty years ago there used to be fish in the creek when the creek was high. In 1954 water reached the top of the bank. In 1961 there was water within 10 inches of the surface. In approximately 1900 -1920, Calabazas was a year-round trout stream. Why did we have to dedicate a 10-foot easement to the District to get a building permit? Water table is dropping – it may not flood again.

**Comment**: SCVWD has messed up the creeks with their meddling and putting in riprap. _Who wants this? – only a few people.

**Comment**: The channel is much flatter than when it was channelized. It keeps getting wider.

**Comment:** That's because the upstream slope is flattened by sediments, and the creek meanders. Meandering is a natural process.

**Comments**: These things should be added to the study.

- Erosion plans downstream at the corner?
- What will happen to the energy that is now being dissipated by the structure?
- Will the wing walls stand if the structure is taken out?

**Answer:** Liang said that bank erosion is a separate issue from the basin study, but we understand the concern. If the dam were removed, the drop would not remain, and the energy the water gained from the drop would not subsist. However, we would look at the entire system before determining any action. The stability of the slope behind the wing walls is certainly one of the issues.

**Comment (Greg Zlotnick)**: He has responded to the concerns of Stan Bogosian, of the Saratoga City Council. These concerns initiated this study. The District would study the impacts, find out what channel slope and shape would be acceptable for a stable system, and what enhancement opportunities there were. Then the Board will evaluate to determine if a follow up project should be initiated.

**Closure**: Liang thanked everyone for taking part in this meeting. The study will continue for another two months to complete the feasibility analysis. He assured the audience that the District heard their comments and concerns expressed at the meeting. Some people wanted the dam out, and some in, but most people wanted the erosion to be maintained. Liang said the District would examine the creek and the debris basin from an overall view to cover the environmental, hydraulic, sediment, and wildlife impacts, and would report back to them near the end of the year.

Quite a few people stayed after the meeting to talk more about the creek, and one of the residents offered to take interested parties on a creek walk.

# Appendix D

## PUBLIC WORKSHOP NO. 2 MEETING MINUTES

# Calabazas Comer Debris Basin
# Community Meeting

Saratoga High School
December 10, 2001 - 7 p.m.

## Meeting Notes

| | |
|---|---|
| District Participants: | Greg Zlotnick, Liang Lee, Jason Christie, Liang Xu, Gerry Uenaka, Beth Redmond, MaryLou Giuffrida |
| Consultant Participants: | Mark Minkowski, (Kennedy-Jenks) |

Introduction by Greg Zlotnick, Jason Christie, and Liang Lee. A report was given on the results of the feasibility study by the District's consultant, Mark Minkowski (Kennedy-Jenks). Mark provided a summary PowerPoint presentation, went over the background and description of the site, and an update of the study.

### Questions/Comments from audience

**Question**: What is the capacity of the basin?

**Answer**: 9,000 cubic yards.

Mark Minkowski went over technical and environmental concerns.

**Questions**: Why is there a project at all? Is it because it's ugly? Does the City have lots of money? What is the point of removing the dam?

**Answer**: This is a city-owned bridge. If a tree fell or if garbage is dumped in the creek, it could back up or the bridge could be damaged and cause flooding. You can't walk under it. There would be less of a creek backup in a normal channel.

(Greg Zlotnick): Environmental reasons, habitat enhancement. We need to look at these issues.

**Comment**: There are no fish on the west side. A few years ago the water got as high as the bridge soffit. It then started flowing over the wing wall and the wall would have been the first thing to fail. The District backfilled behind the wing wall.

**Comment**: What are the bank stabilization methods to be used here? What will be the increase in velocity if the project is built?

**Answer**: (Liang Lee) When the creek is channelized the flow will be straighter with less erosion. The velocity will increase proportional to the slope.

**Comment**: Further downstream the water moves from one side, then you build it up and it moves over to the other side and erodes.

**Answer**: (Liang Lee) If the creek is to be modified, we will design a stable cross section.

**Comment**: This will only be a temporary solution and I disagree about the poor aesthetics and access. People are here every weekend with kids and dogs. It is used on a regular basis.

**Comment**: Build up the basin and let the sediment go down naturally.

**Question**: Have you looked at decreasing the velocity of the water? Because if there is high velocity my property erodes and can flood.

**Answer**: (Liang Lee) We will look at erosion and flooding before we design.

**Comment**: If you narrow the channel the velocity will increase.

**Answer**: (Liang Lee) We have the knowledge and expertise to make sure there will be no erosion and flooding.

**Comment**: When the creek is flowing it is brown, so it is full of sediment.

**Comment**: You will always get sediment coming down. If you don't go up more than 100 feet, Bill McSweeney's property will be OK. Leave my wall where the oak tree is.

**Comment:** With Alternative 1, the bridge will not flood; the wall will be washed out first.

**Question:** Was that for a 100-year flood?

**Comment:** Not much gravel coming from the rain.

**Comment**: I disagree; the creek is full of rock and stuff when it rains.

**Answer**: (Liang Lee) You are both correct; you will see gravel/rocks and the supply is still reduced.

**Comment**: The rocks/gravel promote erosion. The effect on the walls is erosion. Neighbors worry about undercut of downstream.

**Comment**: Taking out the dam will not decrease the sediment downstream.

**Comment**: The basin is full.

**Comment**: It seems like you could make a determination with simple engineering calculations. You should do that. How much clearance between the dam and bridge? Make an assessment of what will happen to the bridge without the dam.

A resident asked Stan Bogosian about flooding the year before. "Will it happen again?" Stan said he did not know, could not answer.

**Question**: Stan Bogosian asked about Alternate 2. What kind of maintenance would be needed?

**Answer**: (Jason Christie) two types of maintenance are needed; one to establish vegetation, and then two inspections a year would be needed. There shouldn't be any more than any other creek.

**Comment**: (Alternate 4) If you remove part of headwall, the first rain will do the excavation work for you.

**Question**: Has the District chosen an alternate or is there some reason they want to do it?

**Answer**: (Greg Zlotnick): No alternative is preferred.

**Comment**: (Stan Bogosian): Some safety and environmental benefits will be realized.

**Comment**: (Greg Zlotnick): The District undertook this study to look at the Comer Debris Basin in response to concerns they heard from the City and some residents.

**Comment**: (Stan Bogosian) Would the District be willing to indemnify the City for the failure of the bridge?

**Comments**: A 5th alternative could be to clean the debris from the basin. The bridge does catch debris. When this happens I call the District and they clean it out. They also clean it out between storms.

**Comment**: Several residents support removing the top row of teeth along the dam.

**Question**: Is there an option to make money instead of spending it?

**Answer**: (Greg Zlotnick): Before Measure B, only money collected in rates could be used. After Measure B, more money is available for maintenance.

**Question**: What was the cost of cleaning out the basin in 1992?

**Answer**: (Liang Lee) Now it is $15. a yard.

**Comment**: (Liang Lee): This is new information that water went over the wing wall.

**Question**: Why did you put in the debris basin?

**Answer**: (Jason Christie): Since that time we have changed from having too much sediment to not enough.

**Comment**: Make sure you keep the debris basin cleaned out.

**Comment**: I bought after the dam was in; I need the same protection.

**Question**: Is there a voting? How do we decide?

**Answer**: (Greg Zlotnick): We will continue discussion with the City about their concerns. Staff will look at the safety issue with the bridge and a modified Alternative Three of removing some teeth. We will have another meeting to look at the environmental issues. At the next meeting, staff will have a presentation with more detail about exactly what the District will do to ensure there is not additional erosion.

**Comment**: (Stan Bogosian): We would not want to threaten any property, even for environmental benefits.

**Closing Comments**: (Liang Lee) We have heard your concerns. There are two major issues: Flooding at the bridge, and erosion, which is a meandering process. Now we will go back and look at the process and the feasibility study and take a recommendation to the Board in July.

# Appendix E

## MINUTES AND PUBLIC COMMENTS –
## CITY OF SARATOGA COUNCIL MEETING
## 6 MARCH 2002

# EXCERPT FROM MINUTES
# SARATOGA CITY COUNCIL
# MARCH 6, 2002

The City Council of the City of Saratoga met in Closed Session, Administrative Conference Room, 13777 Fruitvale Avenue at 5:00 p.m.

Item No. 7

## COMER DEBRIS BASIN MODIFICATION PROJECT

STAFF RECOMMENDATION:
Accept report and direct staff accordingly.

John Cherbone, Public Works Director, presented staff report.

Director Cherbone explained that attached to staff report Council received a copy of the Comer Debris Basin Engineering Feasibility Study and noted that the Santa Clara Valley Water District staff was here tonight to present a report to Council on the status of the Comer Debris Basin Modification Project.

Director Cherbone noted that the Modification Project was a study to determine the impact of the basin on the creek and watershed, and the potential impacts of removing the basin. The study examined the following issues: hydraulic, hydrologic, sedimentation, basin removal options, adverse and beneficial environmental impact, and whether the removal of the debris basin benefits the watershed.

Director Cherbone noted that the District held two public meetings to gather input and a notice of tonight's meeting was sent to the District list of interested parties.

Director Cherbone noted that the District's report includes various alternative solutions such as:

1. Alternative 1 – Do Nothing.
2. Alternative 2 – remove entire headwall and wingwalls. Grade channel in uniform slope 1,300 feet upstream of Comer Drive.
3. Alternative 3 – Remove entire headwall and wingwalls. Construct a stepped channel to create small falls and pools. Grade slope 500 feet upstream of Comer Drive.
4. Alternative 4 – Remove upper 3 feet of headway, leave wingwalls. Grade uniform slope 50 feet upstream of Comer Drive. Construct single step at upstream end to match existing channel bed.

Director Cherbone briefly explained the history behind the Comer Debris basin stating that is was constructed in 1973 to assist the District in maintaining the Calabzas Creek Channel capacity for high winter flows. Although the basin worked effectively to impound sediment, there may have been downstream impacts. Director Cherbone noted that the current need of the debris basin is out how much it would cost to fix that problem. Raise the bridge and regrade the approaches to the bridge for approximately $300,000.

Councilmember Bogosian asked if any of the mitigation efforts presented tonight would make it worse for the property owners downstream.

Mr. Christie responded if the dam and the sediment were removed the flow of sediment would not be changed. Mr. Christie noted that they do not anticipate further erosion downstream.

Councilmember Waltonsmith referred to a diagram in the Feasibility Study and asked if it described the District decision to try and even out the slope. .

In response to Councilmember Waltonsmith, Mr. Christie explained that the District has not made a decision; the Feasibility Report was intended to look to several different scenarios.

Mr. Christie explained Alternative 3, stating that the District could remove the entire headwall and wingwalls, construct a stepped channel to create small falls and pools.

Mayor Streit stated that Alternative 3 would have the least impact upstream.

Councilmember Mehaffey asked what the District would do with the sediment they would be removing from the creek.

Mr. Christie explained that it is good soil; the District could probably sell it to a contractor for a road project.

Councilmember Mehaffey asked who would pay for the proposed project.

Director Zlotnick responded that it might come out of a zone account or from funds generated from Measure B.

Robert Wallace, Foothill Lane, stated that he would like to see the creek restored back to the way it was in 1973. Mr. Wallace suggested that the dam and the walls on the west side be removed. Mr. Wallace noted that the other wall should stay in order to save an oak tree. In regards to all the sediment, Mr. Wallace suggested placing it all on the west side and any extra should be left to flow downstream naturally.

Lawrence Clifford, 12985 Pierce Road, noted that he has followed this project from the beginning. Mr. Lawrence noted that the after reading the Comer Debris Basin Engineering Feasibility Study; he found that nowhere did it mention erosion control. Mr. Clifford noted that the property owners downstream have lost parts of their yards due to erosion. Mr. Clifford urged the Council not to support this project.

Patty Ting, Wardell Road, noted that she representing her mother. Ms. Ting noted that she agrees with Mr. Clifford that erosion is their main concern.

Mr. Zlotnick noted that the Feasibility Report was not intended to address all of the concerns voiced tonight. Mr. Zlotnick noted that as the project moves forward a CEQA report would have to be done by the District.

If the project moves forward, Councilmember Bogosian asked who would be responsible if erosion does occur.

Mr. Zlotnick noted it is the District's project.

Councilmember Mehaffey stated that he feels the less grading the better because of possible heavy metals and other toxic substances that could be in the soil.

Mr. Zlotnick responded that the Regional Water Quality Control Board mandates soil testing.

Councilmember Waltonsmith noted that she supports the District's efforts but noted that she does not want the creek to be damaged any more that it already has.

Councilmember Bogosian noted that he supports Alternative 3.

Vice Mayor Baker asked Mr. Zlotnick what he would do to address his three concerns in regards to the homeowners who live along the creek: 1) flood control 2) minimizing erosion 3) least impact.

Mr. Zlotnick noted that he does not have enough information to make any suggestions. Mr. Zlotnick noted that he needs direction from the City Council to go forward with the project or were there enough questions on potential impact to where the project should not go forward. Mr. Zlotnick noted that he would be willing to come back in a few months and give the Council another update.

Vice Mayor Baker noted that he feels the City Council does not have enough information to make a recommendation on the project.

Mr. Zlotnick noted that there is enough information to know that the District will be able to mitigate impact.

Mayor Streit noted that he feels this project should go forward and perhaps come back to the Council after the District completes their process.

GUADALUPE - COYOTE
RESOURCE CONSERVATION DISTRICT
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OFFICE (408) 288-5888 FAX (408) 993-8728 email: gcrcd@pacbell.net

February 4, 2002

Board of Directors
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3614

Subject: Calabazas Creek Sediment Dam

Our office was contacted several weeks ago by a Mr. Bob Wallace, a Saratoga, CA resident. Mr. Wallace has a home on Calabazas creek at 12881 Foothill Lane, just off Pierce Road. He indicated that there was a dam on the creek about a quarter of a mile upstream of his house that was causing all sorts of problems in the creek. He asked if the GCRCD could provide any type of support to him and a number of his neighbors in their effort to get the dam removed.

According to Mr. Wallace, the dam was constructed in the early 70's either by or under the purview of the Santa Clara Valley Water District (SCVWD) with the goal of trapping sediment in the upstream reach of the creek to prevent its accumulation within the levees near the Bay. Accumulation of sediment in the lower reaches of the stream decreases the water carrying capacity of the stream that would lead to flooding of that industrial area. For several years the SCVWD reportedly removed the sand/gravel that accumulated behind the dam each spring. However, it turned out that sediment still built up just as fast down by the levees, requiring a continuing removal process in both areas. Thus, the dam increased operating cost as two sediment removal operations were required instead of just one. Because the dam blocked sediment from going down the creek in a normal manner the creek below the dam became sediment starved and started to down-cut and cause a lot of bank erosion, which resulted in quick fix attempts to repair the damage and halt the erosion process. As a result of this the SCVWD discontinued removal of the sediment behind the dam a number of years ago but the dam remains in place.

Mr. Wallace stated that he has been asking the SCVWD to remove the dam for a number of years and believes they are now in favor of doing so but a few people oppose its removal. He said the SCVWD and the Saratoga City Council are somewhat uncertain of public's support for a dam removal and creek restoration project. He believes that Measure B funding is available to pay for this effort.

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On January 12th, one of our Associate Directors, Larry Johmann, walked Calabazas Creek with Bob from a point several hundred yards above the dam to a point about a half a mile below it. He reported that the severe impacts the dam was having on the creek were clearly obvious and documented his observation with photographs, Ref. Attached. Sediment has now built up to the top of the dam, about 10 feet high and has backed upstream, elevating the natural creek bed above the dam. The sediment has backed up under the Comer Drive Bridge, about a 100 yards above the dam and now the corridor does not have the capacity to carry expected flood flows. Upstream of the bridge, the stream is attacking the banks as the water is backed up due to the elevated channel. There was an entire clump of large trees that appeared to have just fallen over in a recent storm just upstream of the bridge. At the top of the dam the creek was in the process of cutting around the dam. The creek channel had split into two and they were attacking the left and right side of the dam. Bob indicated that the creek did cut behind the left wing wall last year but it had been refilled in an attempt to thwart or delay the process.

Down stream of the dam, the creek has probably down cut two to three feet and it is attacking the banks as it attempts to meander back and forth in its confined channel. As property owners try to protect their property they either dump rock or debris over the sides of the collapsing bank or get the SCVWD or City to do so, or they have them install concrete sack armor. The rocks just cause more turbulence and deflect the stream to the opposite bank, which causes more erosion and the concrete sacks accelerate velocity and cause more down-cutting. Just below the installed sacks, eddies form and they eat at the bank, which causes it to collapse and the process just progresses downstream. All of the above problems are very predictable and preventable.

In order to avoid further damage the dam needs to be removed ASAP and the creek channel restored to it more natural condition. Then, high velocities need to be reduced and vectored towards the center of the creek in an effort to reduce or eliminate the bank erosion. These actions will greatly reduce the chance of bank erosion and flood potential in the area and greatly improve the creek for wild and aquatic life, as the dam also serves as a fish and wild life migration barrier.

In view of the above, the GCRCD Board fully supports the efforts by Mr. Wallace and other residents to get the dam removed and restore the creek's natural functions before more serious erosion and flooding occurs. Thank you.

Sincerely,
PRESIDENT
The Board of Directors

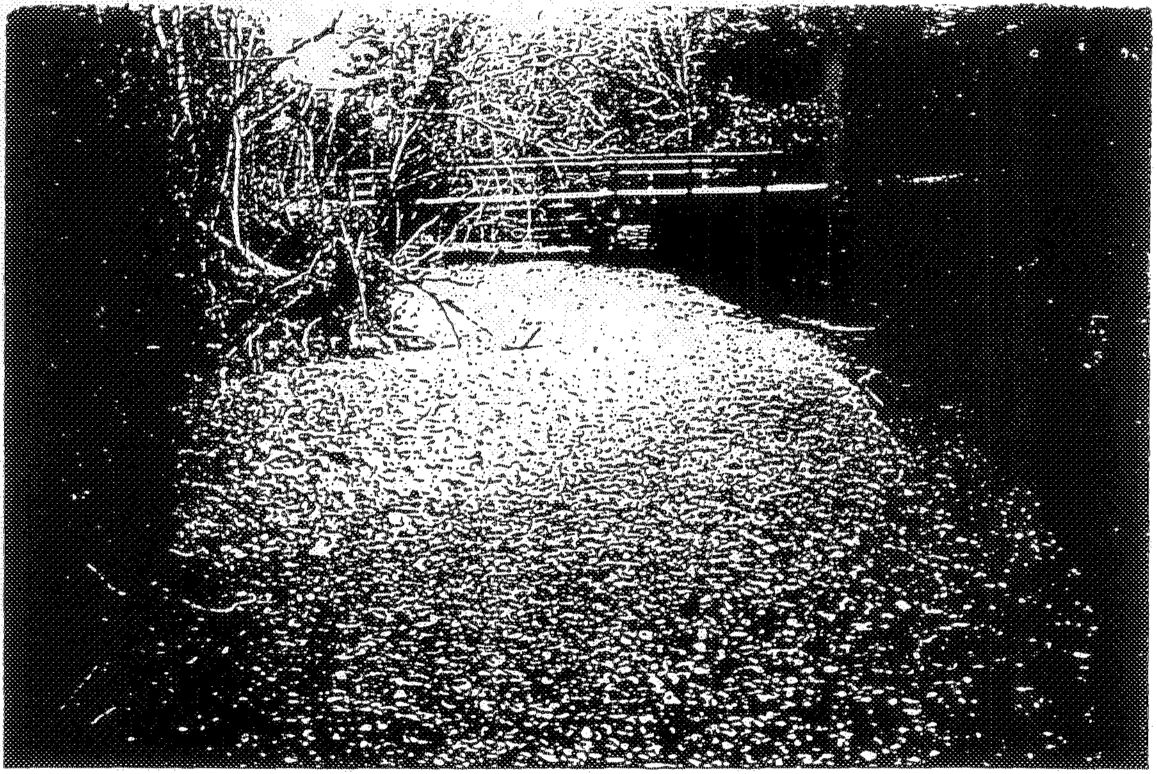


Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking downstream towards the Comer Drive Bridge. Excessive amount of sediment being deposited in this area due to a sediment dam located approx. 100 yards downstream. Sediment has built up to the top of the dam and back filled upstream past the bridge. The creek has migrated to the right side of the bridge and is poised to attack the right wall and will attempt to cut around it at high flows. The creek will overflow the bridge at high flows because excessive sediment has decreased corridor capacity.

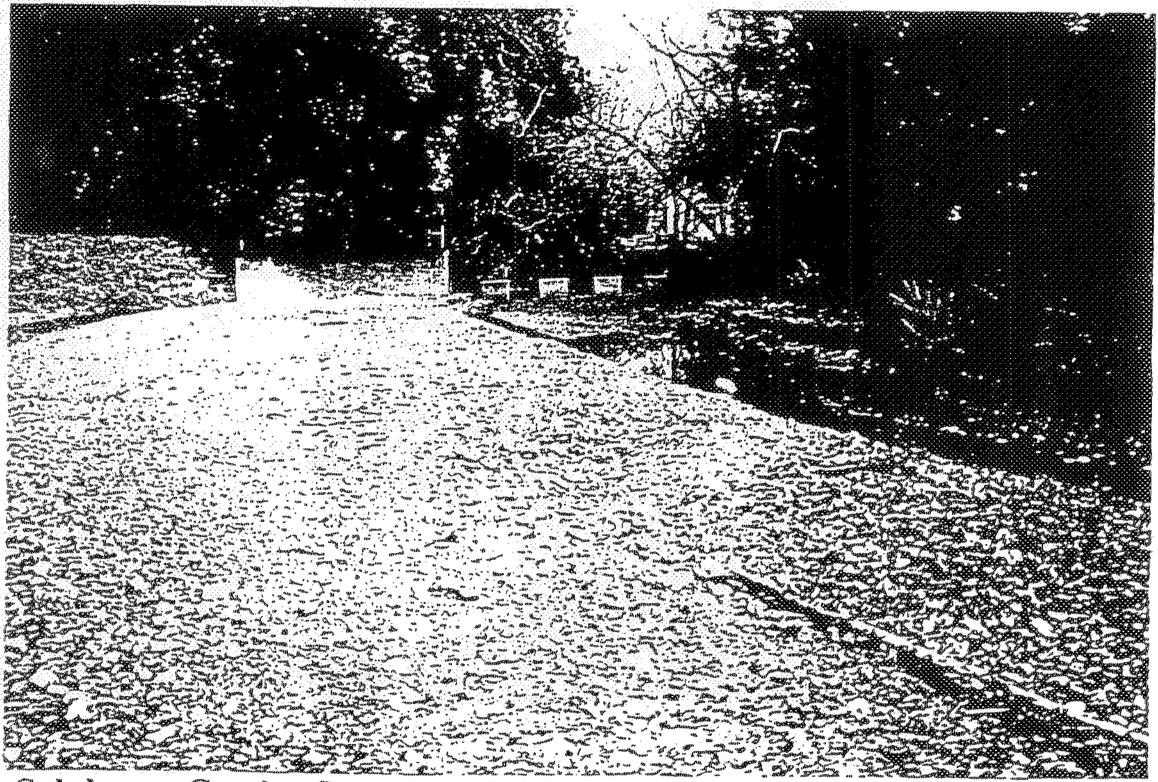


Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Looking downstream below the Comer Drive Bridge. Excessive amount of sediment being deposited in this area is due to the sediment dam pictured in the background. Sediment has built up to the top of the dam and back filled upstream reducing stream capacity and increasing flood potential. The creek has divided into two channels with a gravel bar in the middle and is attacking both banks

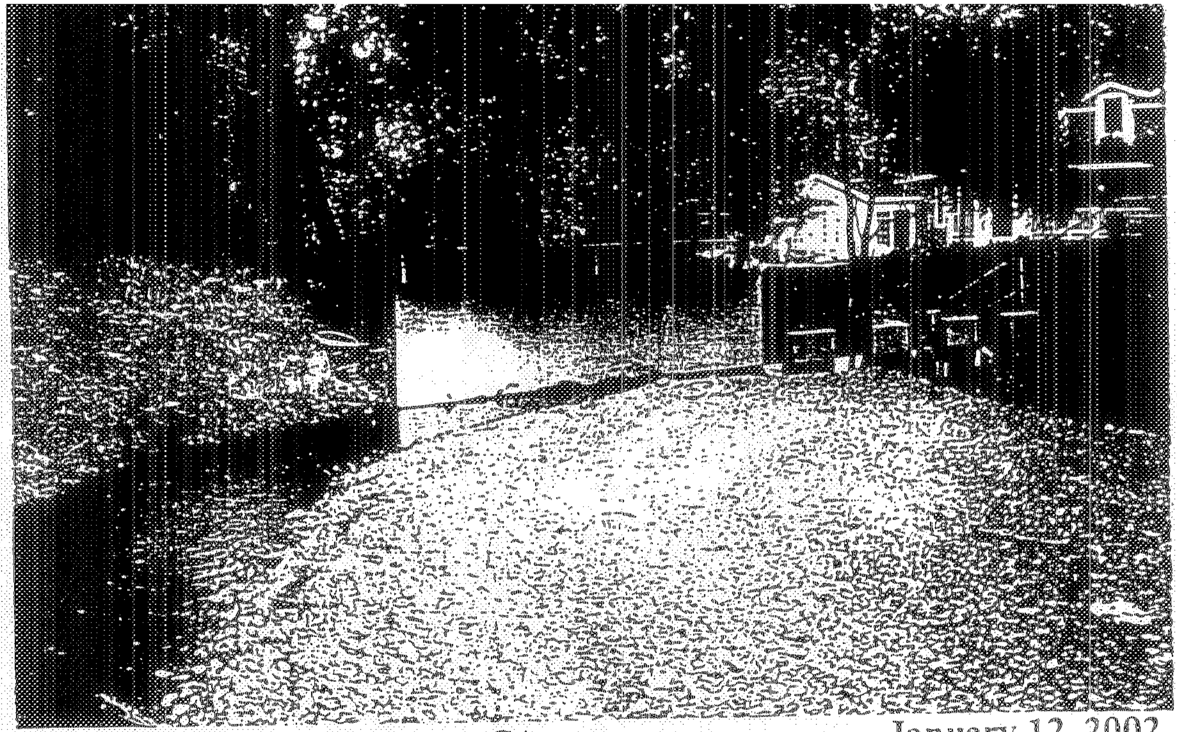


Photo by J.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking downstream below the Comer Drive Bridge. Excessive amount of sediment being deposited in this area is due to the sediment dam pictured in the background. Sediment has built up to the top of the dam and back filled upstream increasing flood potential. The creek divided into two channels with a gravel island between them and is attacking both banks and the dam wing walls. Erosion behind left wall has been filled in at least once in a futile attempt to thwart the process.

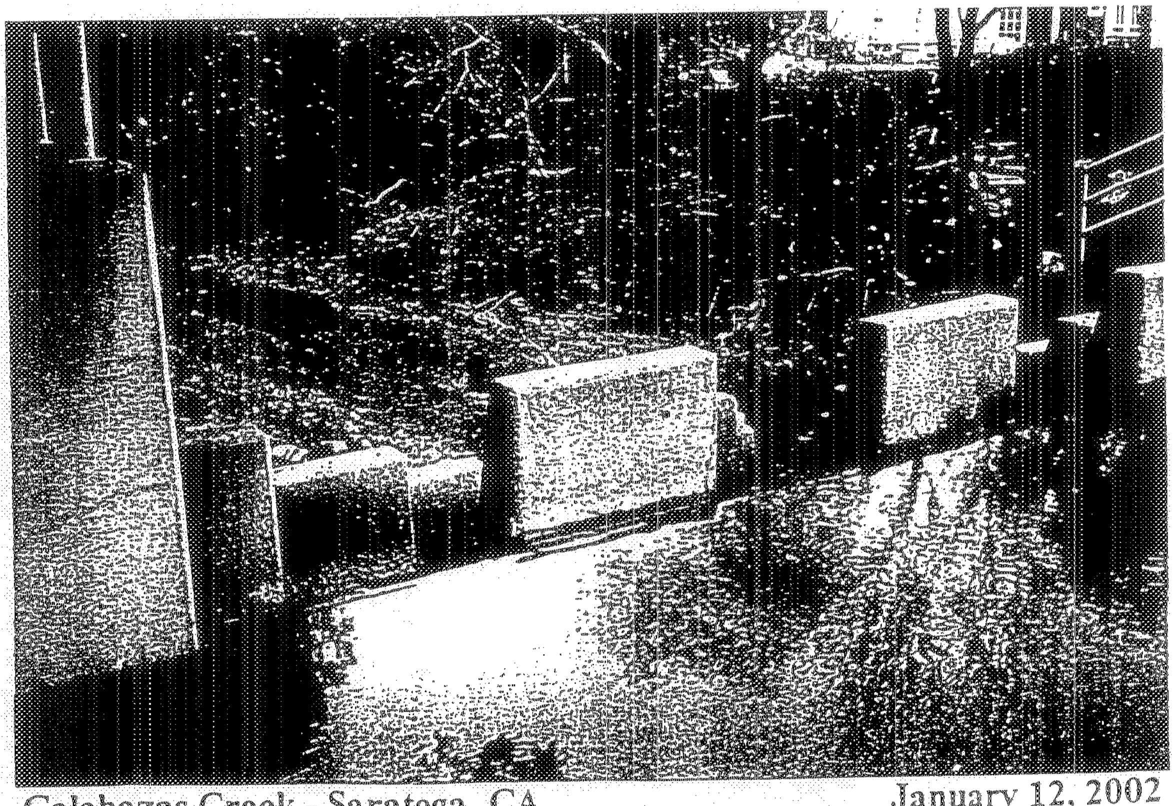


Photo by J.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking over the sediment dam downstream of the Comer Drive Bridge. Sediment trapped by the dam results in sediment-starved water below the dam and severe down-cutting downstream since the replacement sediment has been trapped by the dam. Concrete pillars on the dam face are supposed to dissipate energy. There is evidence of bank erosion on the right bank below the dam and rip rap has been dumped over the bank in a feeble attempt to prevent further erosion.

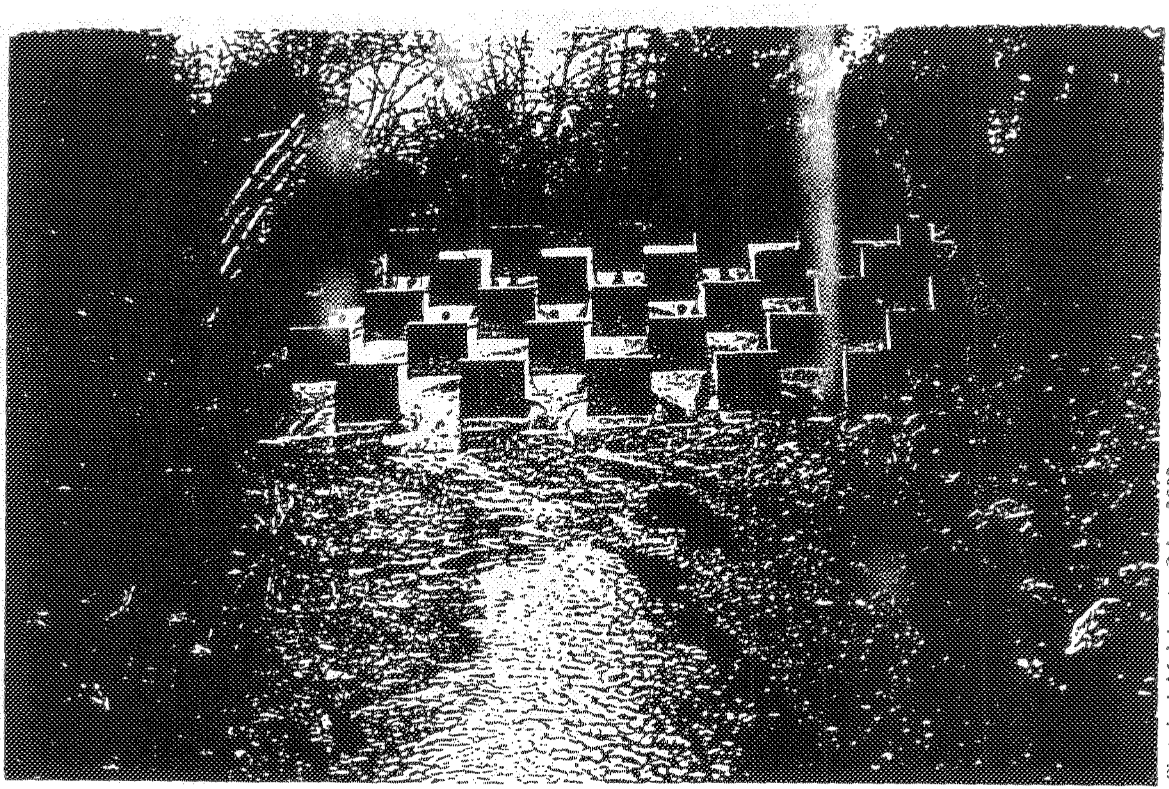


Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking upstream at the sediment dam, downstream of the Comer Drive Bridge. Sediment trapped by the dam results in sediment-starved water below the dam and severe down-cutting downstream. Concrete pillars on the dam face are supposed to dissipate energy. Right bank, top of the dam is eroding behind the wing wall as the creek attempts to cut around it. The area has been filled in at least once in an attempt to thwart the erosion process & the stream's fight to regain its natural form & function.

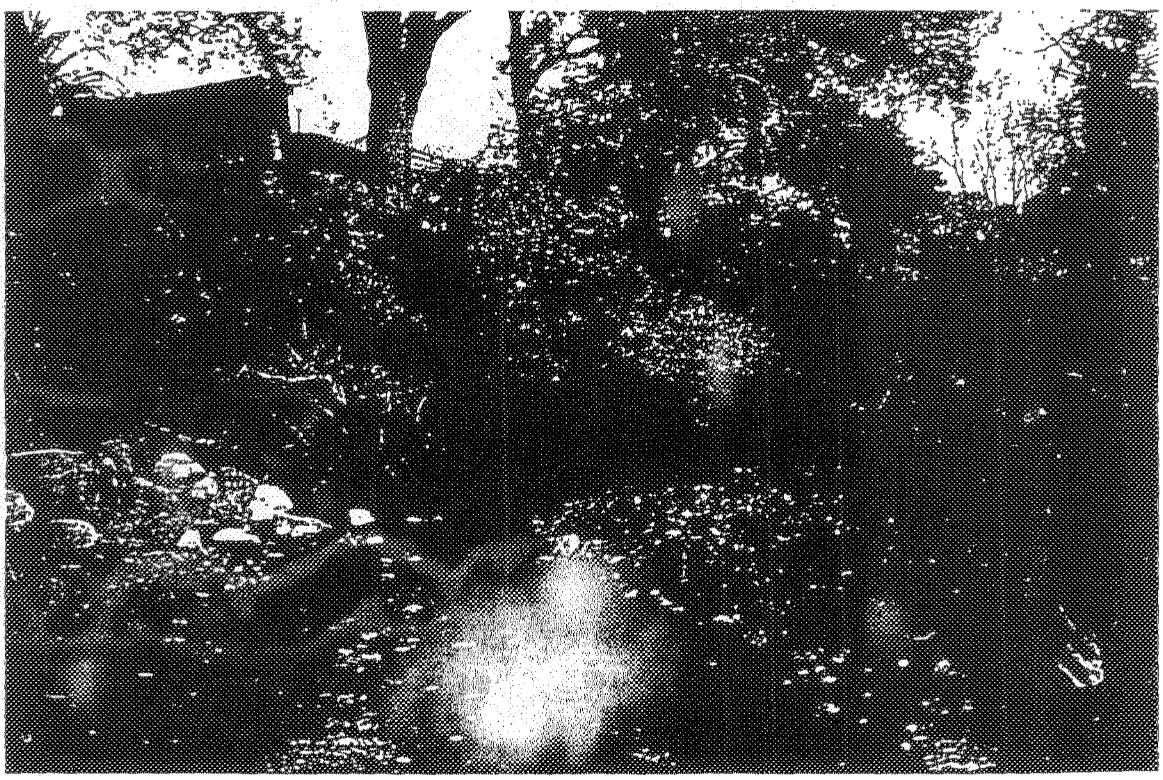


Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking downstream about 100 yards below the sediment dam. Stream appears to have down-cut several feet and is attacking the left bank. Rocks dumped over the bank in attempt to thwart erosion only exacerbates the problem as they cause severe turbulence at higher flows. Erosion & bank cutting are progressing downstream of the rocks. The creek needs to be filled to its former level, the bank sloped &

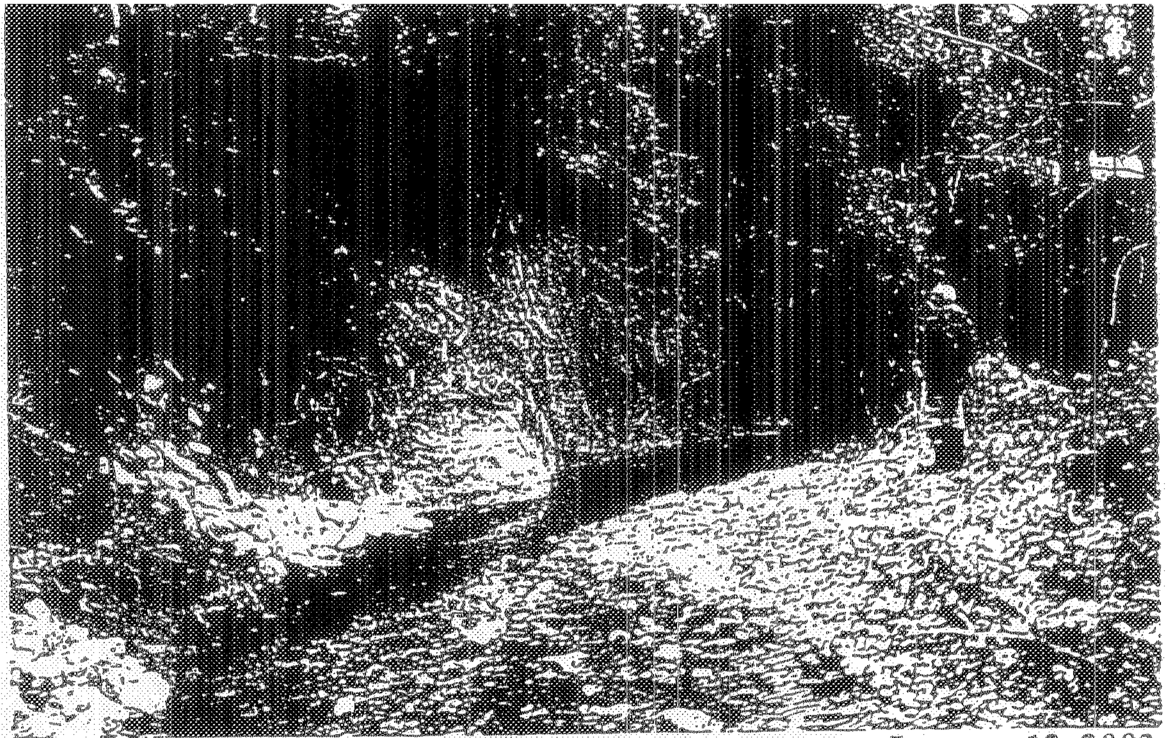


Photo by L.M. Johmann © Jan. 2002

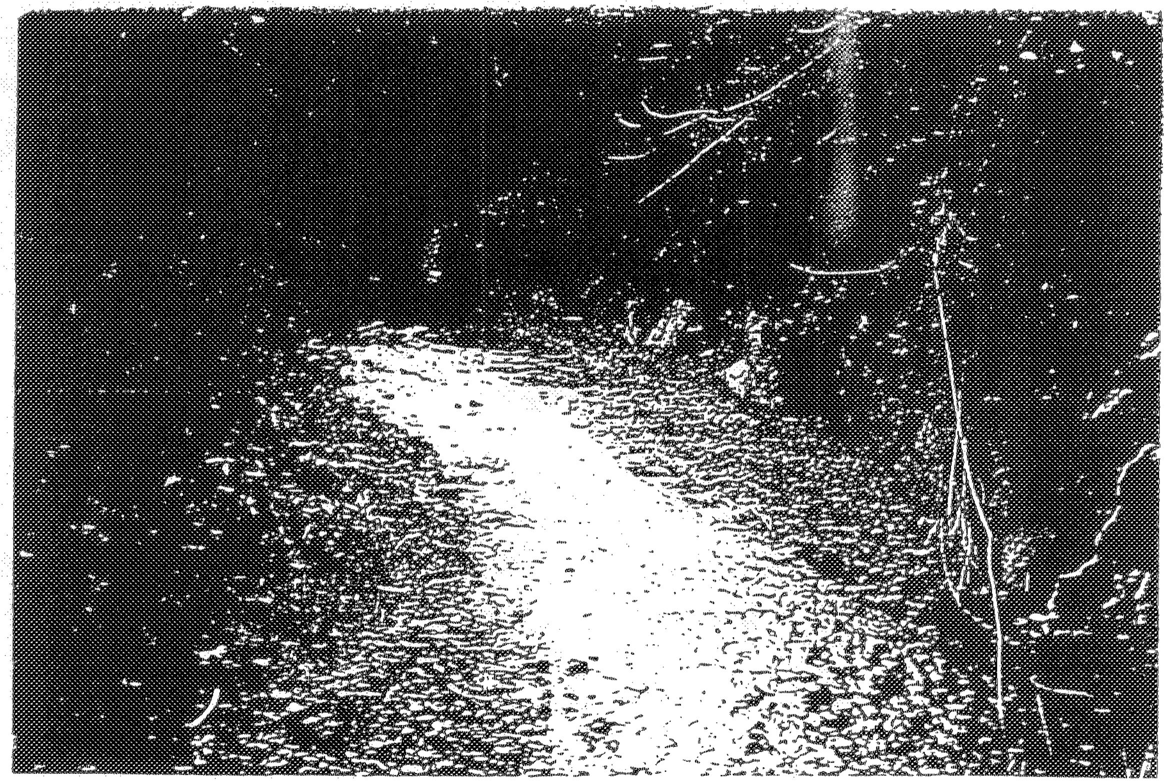
**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking downstream about 200 yards below the sediment dam. Stream appears to have down-cut several feet & is attacking the left bank. Rocks dumped over the bank in attempt to thwart erosion only exacerbates the problem. Erosion & bank cutting are progressing downstream of the rocks. Creek needs to be filled to its former level, the channel moved away from the left bank, the bank sloped & vegetated & a rock/log vane installed to divert high velocities away from the bank.

Photo by L.M. Johmann © Jan. 2002

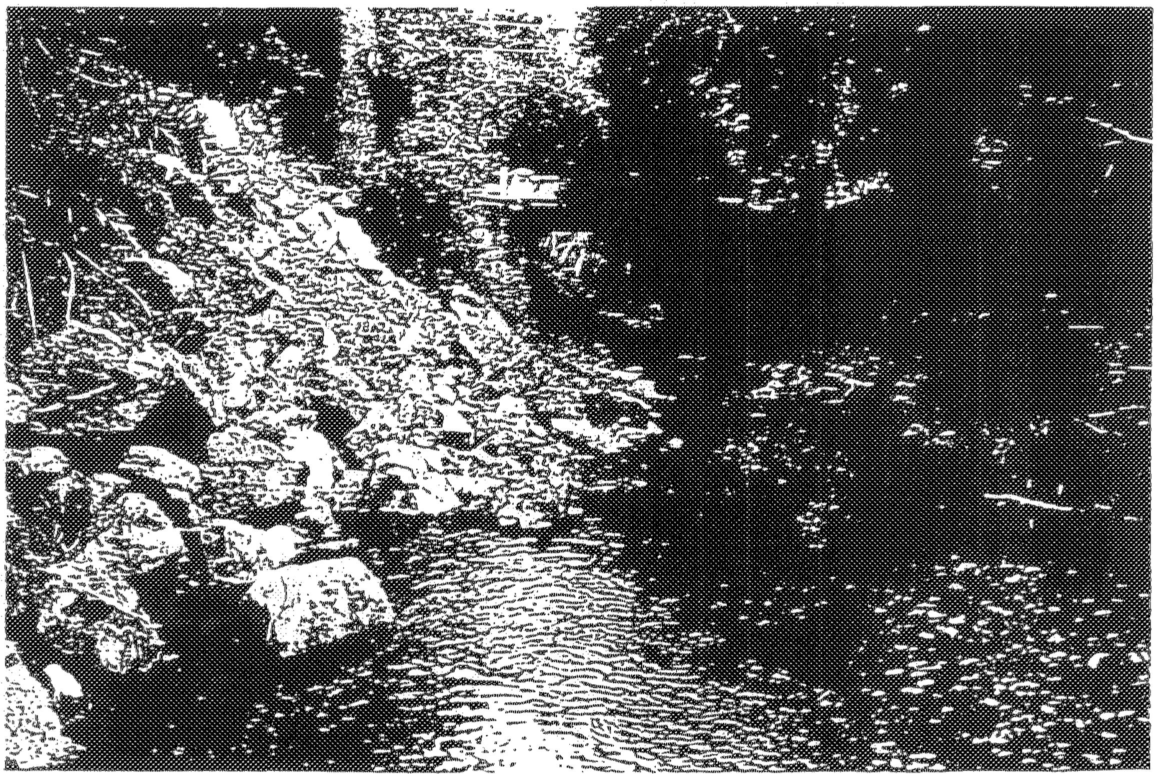
**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, about 300 yards below the sediment dam. Stream appears to have down-cut several feet and is attacking the right bank. Concrete rubble dumped over the bank in attempt to thwart erosion only exacerbates the problem causing turbulence at higher flows. The creek needs to be filled to its former level, the channel moved away from the right bank, the rubble removed, the bank sloped & vegetated & rock/log vanes installed to steer the creek & divert high velocities away from the bank.



**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking upstream approximately 500 yards below the sediment dam. Stream appears to have down-cut several feet and is attacking the right bank. The creek needs to be filled to its former level, the channel moved away from the right bank, the bank sloped & vegetated & rock/log vanes installed to steer creek & divert high velocities away from the bank.



**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking downstream about 75 yards above the Wardell Road Bridge. Rocks dumped over the left bank in attempt to thwart erosion and concrete sacks on the right bank only exacerbates the problem causing accelerated flows and downstream erosion. Concrete weir in foreground provides some down-cutting protection but concrete sacks are being undermined due to high velocities at their base. The creek needs to be filled to its former level, the concrete weir removed, the thalweg channel moved away from

Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, looking upstream about 50 yards below the Wardell Road Bridge. Rocks dumped over the banks in attempt to thwart erosion exacerbates the problem causing high turbulence, accelerated flows and downstream erosion. Concrete weir about 20 yards below bridge provides some grade control but also caused bank erosion. The concrete weir should be removed and a properly designed/installed rock cross vane installed to provide grade control and keep high velocities away from the banks.

Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, approx. several hundred yards downstream of Wardell Road Bridge. Concrete sack armor on both banks accelerates flows causing down-cutting and bank erosion. Chain link fence with brush and debris dumped behind it, just down stream of the left concrete sack wall, is a futile attempt to stop bank erosion caused by the sacks. Concrete sacks & chain link fence need to be removed & the banks sloped & vegetated.

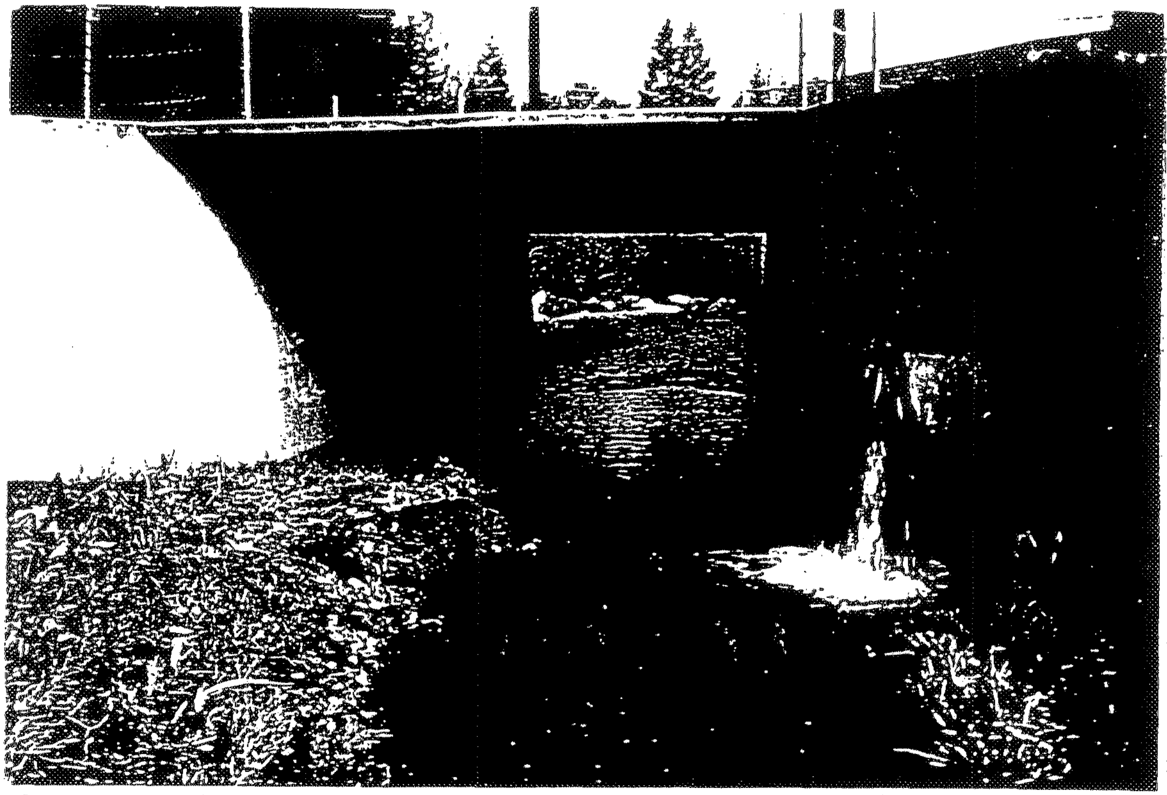


Photo by L.M. Johmann © Jan. 2002

**Calabazas Creek - Saratoga, CA** **January 12, 2002**

Low flow, just upstream of the Southern Pacific Railroad Bridge. Pump outfall provides a little water to the creek all year but it all percolates into the ground in the dry season within a mile downstream. Bridge reportedly will not pass 100 yr. flood flows. The channel is too wide & deposited sediment has reduced capacity. No overflow zone exists so the bridge generates backwater & high velocities/erosion downstream. A modified vortex rock weir would keep the channel sediment free & parallel culvert(s) should be installed above bankfull level to provide high flow relief & reduce erosion.

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**LOMA PRIETA CHAPTER**
San Mateo • Santa Clara • San Benito Counties

25 February 2002

Mayor Nick Streit and Members of Saratoga City Council
13777 Fruitvale Ave.
Saratoga, CA 95070

Re: Comer Debris Basin and Dam

Dear Mayor Streit and Council:

As you are aware, the Santa Clara Valley Water District has proposed to remove the dam and debris basin at Calabazas Creek and Comer Drive, and restore the Creek and its banks to their natural state. The dam was originally constructed in the early 1970's to collect gravel and sediments coming down the creek from the Cocciardi quarry and the residential construction upstream, so the debris would not collect by the levees where Calabazas enters the Bay, raising the water level there during storms and endangering the new industries springing up there. Consequently, the creek below the dam was starved for replenishment and the creek floor lowered a bit each year, exposing and endangering footings of bank armoring at various spots downstream. For a number of years, the Water District removed 8 feet of gravel and sediment from the basin each summer--and still had to remove sediment by the Bay. After the quarry ceased operations and home construction in the watershed slowed down, the Water District stopped clearing out the basin. The Creek has resumed its normal sediment deposition down its length--but the eyesore of the dam and debris basin remain, and clearance below the Comer bridge is so reduced as to threaten the bridge with overflow in heavy storms.

In the early 1900's, Calabazas Creek was an all-year trout stream and wildlife corridor. As the Valley water table has dropped and the Water District and ranchers constructed check-dams in the Creek, fish no longer spawn here--but it remains a seasonal stream and could be an all-year wildlife corridor if the dams and 'drop constructions' were removed. The Sierra Club strongly supports the Water District's proposal to remove the dam and restore the original creek gradient and riparian habitat. Saratoga has had a history of requiring wildlife adaptation for development in the hills--the Water District's proposal is a good fit for that policy, and we trust the City Council will approve the rehabilitation of Calabazas Creek. A member of our Group be at your hearing on this matter, and will speak if needed.

For a sustainable society and a restored environment – sincerely,

TN/nw
Teresa Nemeth, Chair
Guadalupe Regional Group
Loma Prieta Chapter, Sierra Club

cc: Greg Zlotnick, Director, District 5, Santa Clara Valley Water District

Santa Clara Valley
Audubon Society

Founded 1926

March 4, 2002

Saratoga City Council
13777 Fruitvale Ave.
Saratoga, CA 95070

Dear Mayor Streit and Council:

Over the past year, the Santa Clara Valley Water District (SCVWD) has been investigating the impacts of removing a dam and debris basin at Calabazas Creek and Comer Drive. I am writing on behalf of the Santa Clara Valley Audubon Society to express our support for the Water District's efforts to remove barriers in order to improve fisheries, habitat, and stream function. Prior to removal of Comer Dam, however, we feel that SCVWD should consider the project in the context of the entire watershed. We are aware that SCVWD must carefully choose which projects it undertakes due to budget constraints, and we encourage them to focus on projects that are environmentally feasible and economically viable. We encourage you to evaluate this project using the same criteria.

According to the district engineer, there have not been fish sitings in the Comer Dam reach in the recent past. This may be due to a six foot drop further down the creek under the bridge by Bollinger Drive, which acts as a barrier for steelhead and other fish. While you are considering removal of Comer Dam, you may want to also consider how to improve the Bollinger drop structure, which has dramatically altered the creek habitat.

Thank you for your time and consideration. Should you have any questions, please feel free to call me at (408) 252-3747 or email me at advocate@scvas.org.

Sincerely,

Kelly R. Crowley
Environmental Advocate

22221 McClellan Road, Cupertino, CA 95014 Phone 408 • 252 • 3747 Fax 408 • 252 • 2850
e-mail: scvas@scvas.org
www.scvas.org

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# Appendix F

## HYDRAULICS MODEL FILES

## Appendix F: Hydraulics Model Files

This appendix provides the following information:

- A summary description of the U.S. Army Corps of Engineers Hydrologic Engineering Center – River Analysis System (HEC-RAS).

- Appendix F.1: Model input data. This data has been synthesized from the original HEC-2 input files provided by the District from 1978 and 1987, as well as survey data collected in 2001. Input data is provided in the form of the input screens from the HEC-RAS model for each cross section between the Pierce Road bridge and the Union Pacific Railroad bridge.

- Appendix F.2: Output summary data. The output summary consists of graphical representations of the water surface elevation at each of four bridges in the study reach. These images are provided for the 100-year event for existing conditions (Alt. 1), and for Alternatives 2, 3, and 4. In addition, summary output tables from HEC-RAS are provided for existing conditions and three alternatives for the 100-, 10-, and 2.5-year events.

- Appendix F.3: Wardell Road bridge flow height analysis. Area residents applied a dated marking of the observed flow height on the Wardell Road bridge on 11 February, 1992. The flow measured at the District's Rainbow Drive recording gage for that date was 1,180 cfs, according to gage data provided by the District. The District has indicated that the contribution of flow volume from Calabazas Creek to that gage location is approximately 66%. A flow rate of 778 cfs was run in the HEC-RAS model for existing channel geometry, with a resulting water surface elevation of 338.76 at Wardell Bridge.

# CHAPTER 1

# Introduction

Welcome to the Hydrologic Engineering Center's River Analysis System (HEC-RAS). This software allows you to perform one-dimensional steady and unsteady flow hydraulics. Future versions will support sediment transport calculations.

The current version of HEC-RAS supports one-dimensional, steady and unsteady flow, water surface profile calculations. This manual documents the hydraulic capabilities of the Steady and unsteady flow portion of HEC-RAS. Documentation for sediment transport calculations will be made available as these features are added to the HEC-RAS.

This chapter discusses the general philosophy of HEC-RAS and gives you a brief overview of the hydraulic capabilities of the modeling system. Documentation for HEC-RAS is discussed, as well as an overview of this manual.

## Contents

General Philosophy of the Modeling System

Overview of Hydraulic Capabilities

HEC-RAS Documentation

Overview of This Manual

# General Philosophy of the Modeling System

HEC-RAS is an integrated system of software, designed for interactive use in a multi-tasking, multi-user network environment. The system is comprised of a graphical user interface (GUI), separate hydraulic analysis components, data storage and management capabilities, graphics and reporting facilities.

The system will ultimately contain three one-dimensional hydraulic analysis components for: (1) steady flow water surface profile computations; (2) unsteady flow simulation; and (3) movable boundary sediment transport computations. A key element is that all three components will use a common geometric data representation and common geometric and hydraulic computation routines. In addition to the three hydraulic analysis components, the system contains several hydraulic design features that can be invoked once the basic water surface profiles are computed.

The current version of HEC-RAS supports Steady and Unsteady Flow Water Surface Profile calculations. New features and additional capabilities will be added in future releases.

# Overview of Hydraulic Capabilities

HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The following is a description of the major hydraulic capabilities of HEC-RAS.

*Steady Flow Water Surface Profiles*. This component of the modeling system is intended for calculating water surface profiles for steady gradually varied flow. The system can handle a single river reach, a dendritic system, or a full network of channels. The steady flow component is capable of modeling subcritical, supercritical, and mixed flow regime water surface profiles.

The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profile is rapidly varied. These situations include mixed flow regime calculations (i.e., hydraulic jumps), hydraulics of bridges, and evaluating profiles at river confluences (stream junctions).

The effects of various obstructions such as bridges, culverts, weirs, spillways and other structures in the flood plain may be considered in the computations. The steady flow system is designed for application in flood plain management and flood insurance studies to evaluate floodway encroachments. Also, capabilities are available for assessing the change in water surface profiles due to channel improvements, and levees.

Special features of the steady flow component include: multiple plan analyses; multiple profile computations; multiple bridge and/or culvert opening analysis, and split flow optimization at stream junctions and lateral weirs and spillways.

*Unsteady Flow Simulation*. This component of the HEC-RAS modeling system is capable of simulating one-dimensional unsteady flow through a full network of open channels. The unsteady flow equation solver was adapted from Dr. Robert L. Barkau's UNET model (Barkau, 1992 and HEC, 1997). This unsteady flow component was developed primarily for subcritical flow regime calculations.

The hydraulic calculations for cross-sections, bridges, culverts, and other hydraulic structures that were developed for the steady flow component were incorporated into the unsteady flow module. Additionally, the unsteady flow component has the ability to model storage areas and hydraulic connections between storage areas, as well as between stream reaches.

*Sediment Transport/Movable Boundary Computations*. This component of the modeling system is intended for the simulation of one-dimensional sediment transport/movable boundary calculations resulting from scour and deposition over moderate time periods (typically years, although applications to single flood events will be possible).

The sediment transport potential is computed by grain size fraction, thereby allowing the simulation of hydraulic sorting and armoring. Major features include the ability to model a full network of streams, channel dredging, various levee and encroachment alternatives, and the use of several different equations for the computation of sediment transport.

The model will be designed to simulate long-term trends of scour and deposition in a stream channel that might result from modifying the frequency and duration of the water discharge and stage, or modifying the channel geometry. This system can be used to evaluate deposition in reservoirs, design channel contractions required to maintain navigation depths, predict the influence of dredging on the rate of deposition, estimate maximum possible scour during large flood events, and evaluate sedimentation in fixed channels.

# HEC-RAS Documentation

The HEC-RAS package includes several documents, each are designed to help the modeler learn to use a particular aspect of the modeling system. The documentation has been divided into the following three categories:

| Documentation | Description |
|---|---|
| *User's Manual* | This manual is a guide to using the HEC-RAS. The manual provides an introduction and overview of the modeling system, installation instructions, how to get started, simple examples, detailed descriptions of each of the major modeling components, and how to view graphical and tabular output. |
| *Hydraulic Reference Manual* | This manual describes the theory and data requirements for the hydraulic calculations performed by HEC-RAS. Equations are presented along with the assumptions used in their derivation. Discussions are provided on how to estimate model parameters, as well as guidelines on various modeling approaches. |
| *Applications Guide* | This document contains a series of examples that demonstrate various aspects of the HEC-RAS. Each example consists of a problem statement, data requirements, general outline of solution steps, displays of key input and output screens, and discussions of important modeling aspects. |

# Overview of This Manual

This manual presents the theory and data requirements for hydraulic calculations in the HEC-RAS system. The manual is organized as follows:

> Chapter 2 provides an overview of the hydraulic calculations in HEC-RAS.
>
> Chapter 3 describes the basic data requirements to perform the various hydraulic analyses available.
>
> Chapter 4 is an overview of some of the optional hydraulic capabilities of the HEC-RAS software.

Chapters 5, 6, 7, and 8 provide detailed discussions on modeling bridges; culverts; multiple openings; and inline weirs and gated spillways.

Chapter 9 describes how to perform floodway encroachment calculations.

Chapter 10 describes how to use HEC-RAS to compute scour at bridges.

Chapter 11 describes how to model ice-covered rivers.

Appendix A provides a list of all the references for the manual.

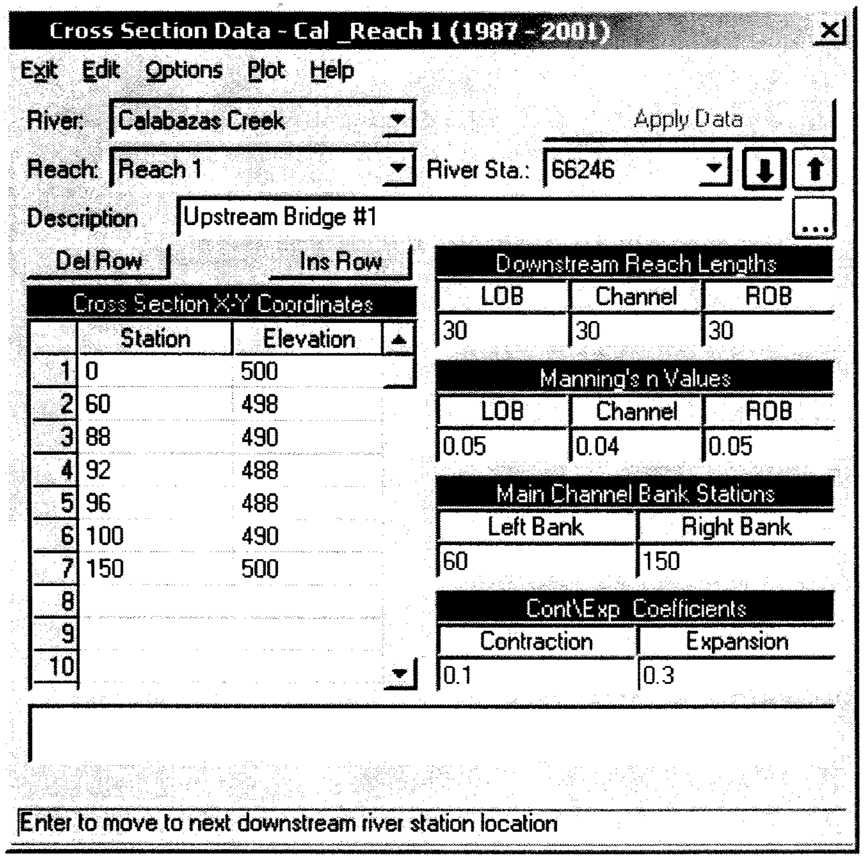
Appendix B is a summary of the research work on "Flow Transitions in Bridge Backwater Analysis."

Appendix C is a write up on the computational differences between HEC-RAS and HEC-2.

Appendix D is a write up on the "Computation of the WSPRO Discharge Coefficient and Effective Flow Length."

# APPENDIX F.1

# INPUT DATA



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 66246

Description: Upstream Bridge #1

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 500 |
| 2 | 60 | 498 |
| 3 | 88 | 490 |
| 4 | 92 | 488 |
| 5 | 96 | 488 |
| 6 | 100 | 490 |
| 7 | 150 | 500 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 30 | 30 | 30 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

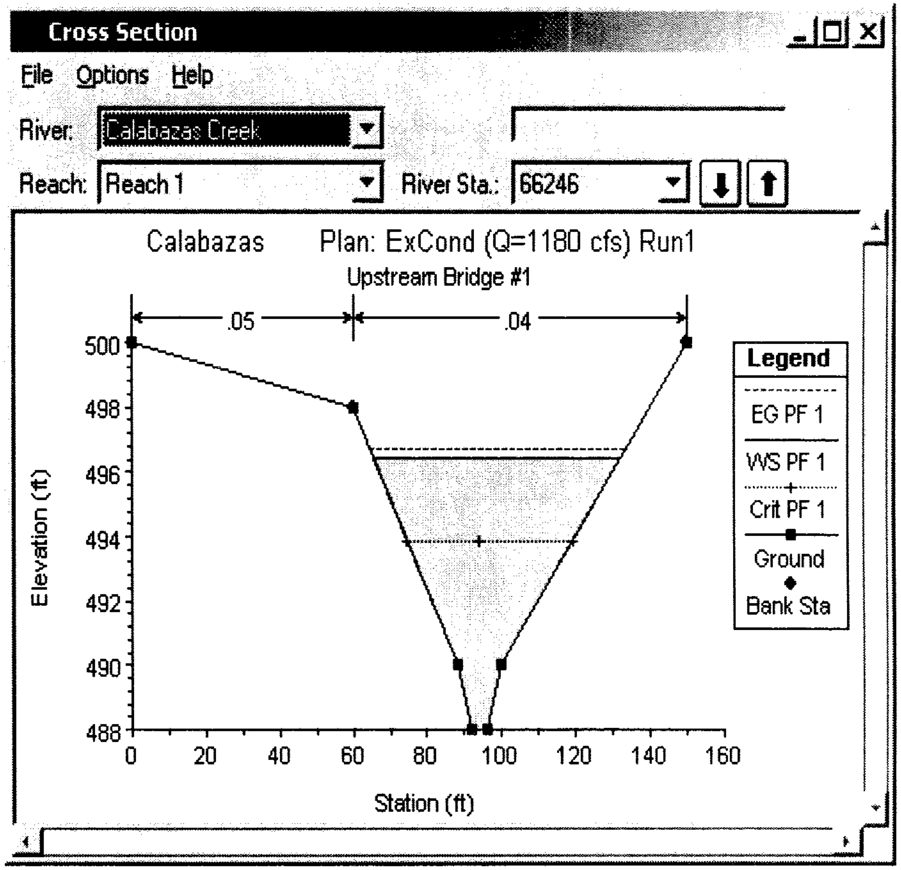
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 60 | 150 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

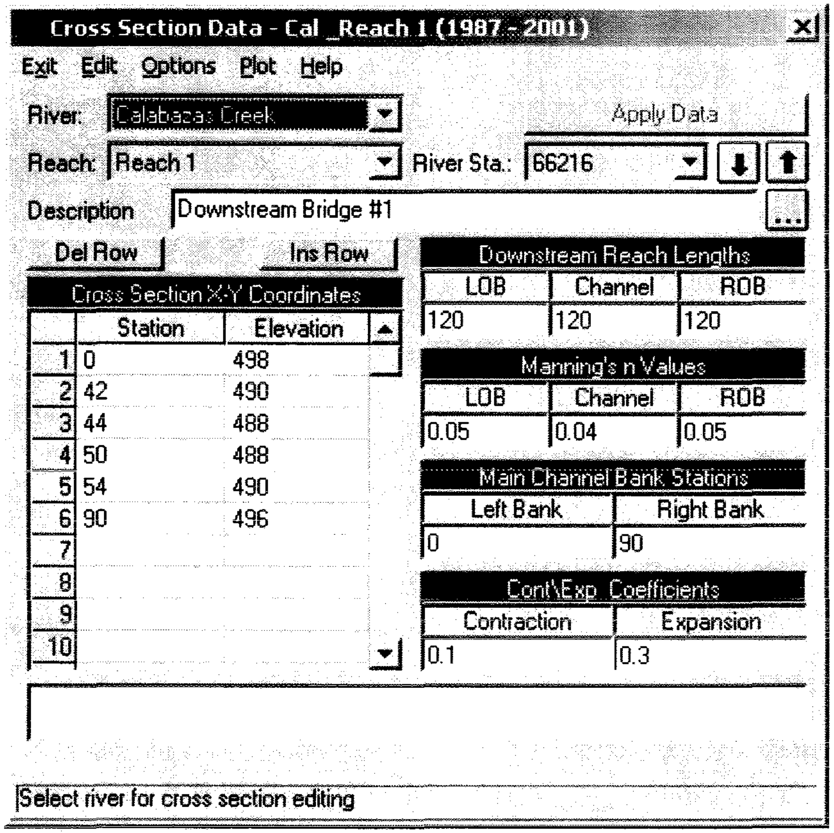
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 66246


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 66216

Description: Downstream Bridge #1

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 498 |
| 2 | 42 | 490 |
| 3 | 44 | 488 |
| 4 | 50 | 488 |
| 5 | 54 | 490 |
| 6 | 90 | 496 |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 120 | 120 | 120 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

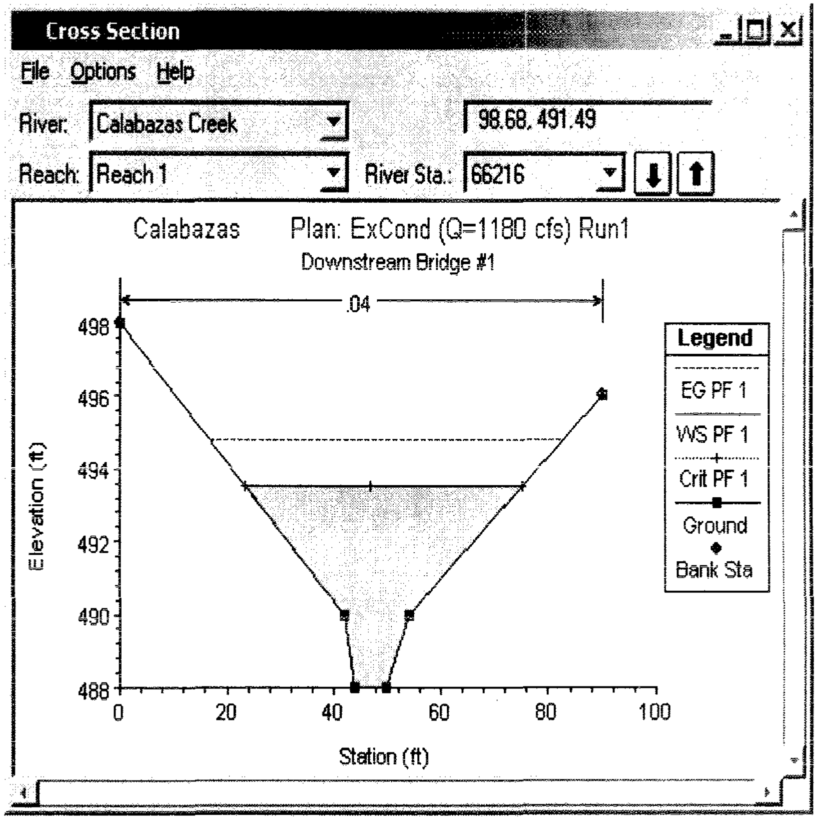
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 90 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Select river for cross section editing



River: Calabazas Creek

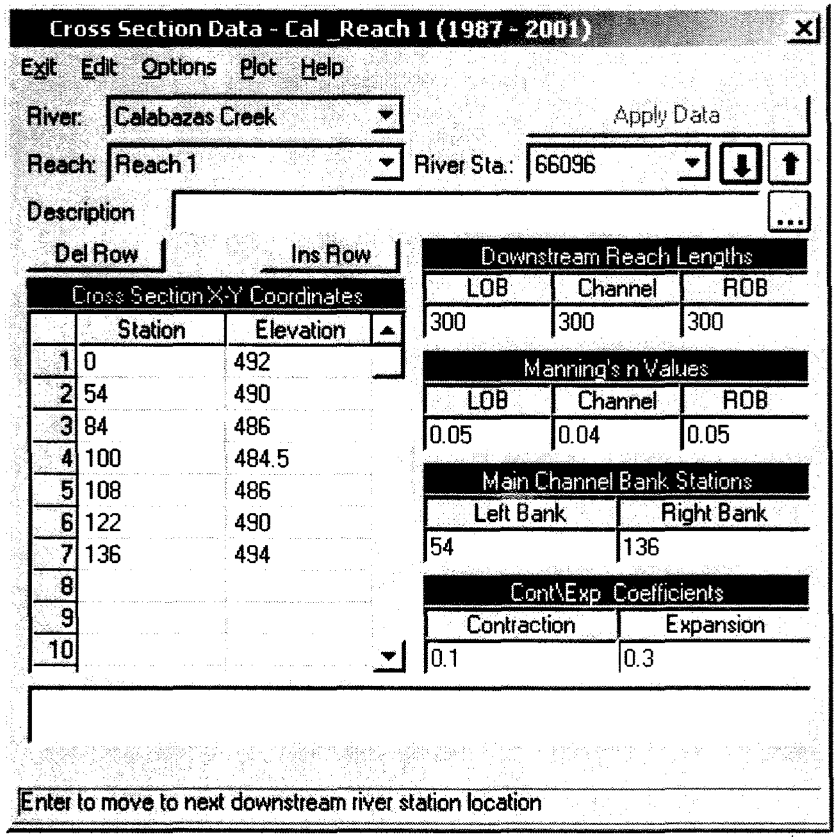
98.68, 491.49

Reach: Reach 1

River Sta.: 66216

Calabazas Plan: ExCond (Q=1180 cfs) Run1

Downstream Bridge #1



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 66096

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 492 |
| 2 | 54 | 490 |
| 3 | 84 | 486 |
| 4 | 100 | 484.5 |
| 5 | 108 | 486 |
| 6 | 122 | 490 |
| 7 | 136 | 494 |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 300 | 300 | 300 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

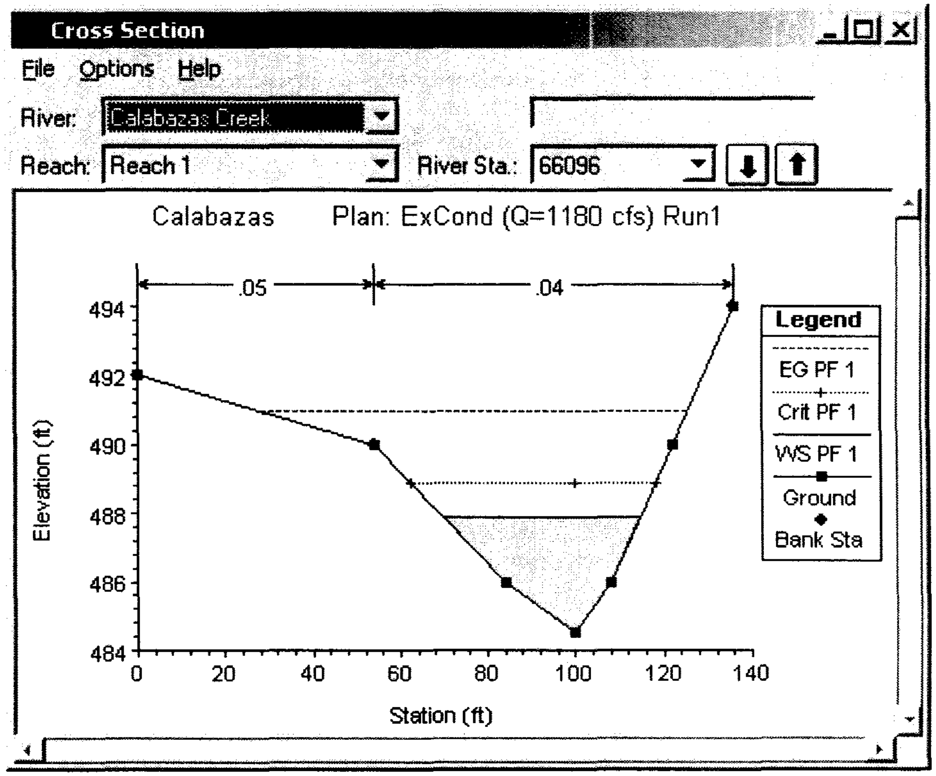
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 54 | 136 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

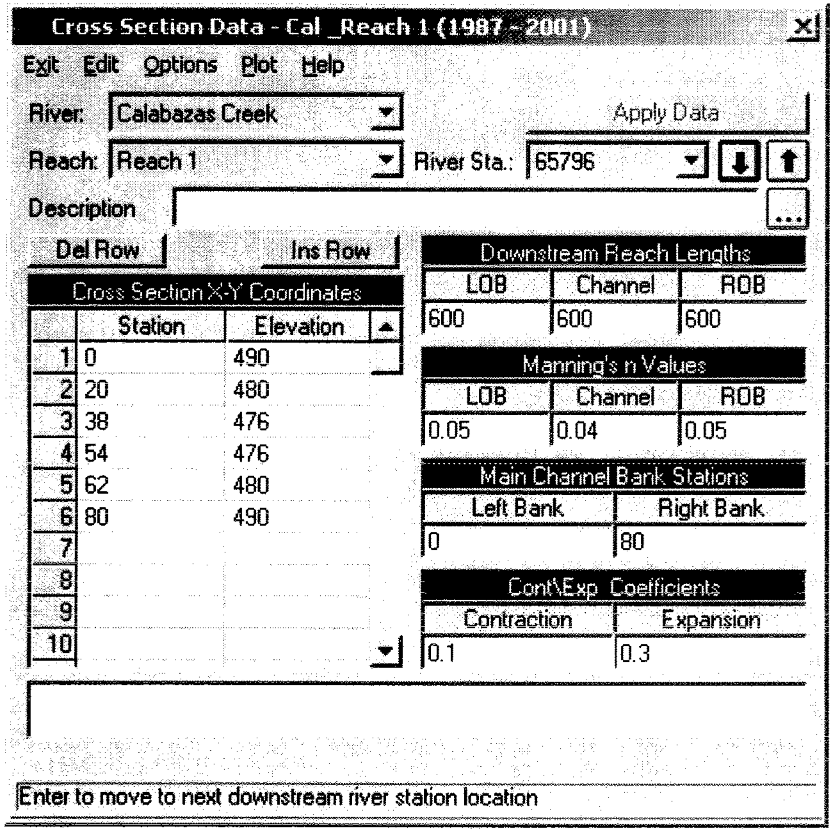


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 66096



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 65796

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 490 |
| 2 | 20 | 480 |
| 3 | 38 | 476 |
| 4 | 54 | 476 |
| 5 | 62 | 480 |
| 6 | 80 | 490 |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 600 | 600 | 600 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

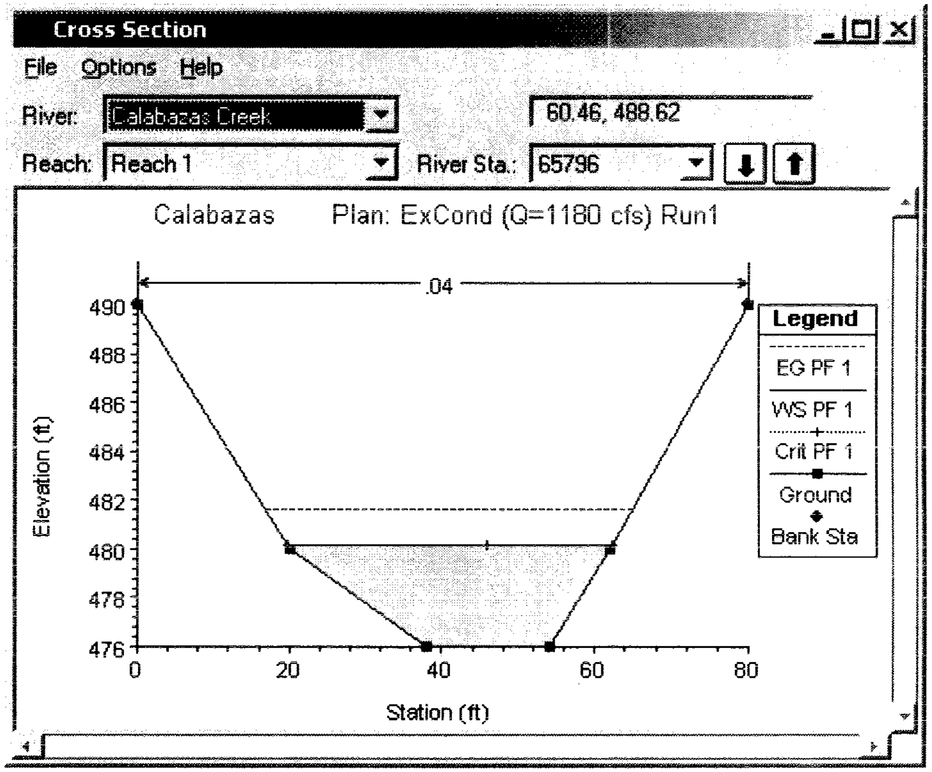
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 80 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



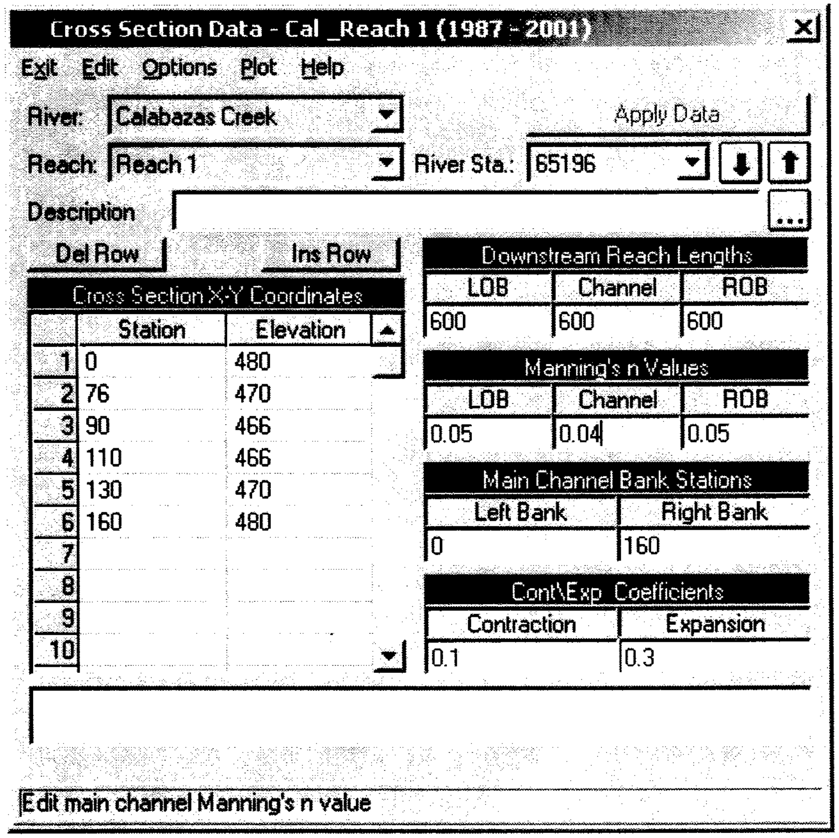
Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 65796

60.46, 488.62



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 65196

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 480 |
| 2 | 76 | 470 |
| 3 | 90 | 466 |
| 4 | 110 | 466 |
| 5 | 130 | 470 |
| 6 | 160 | 480 |
| 7 |  |  |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 600 | 600 | 600 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

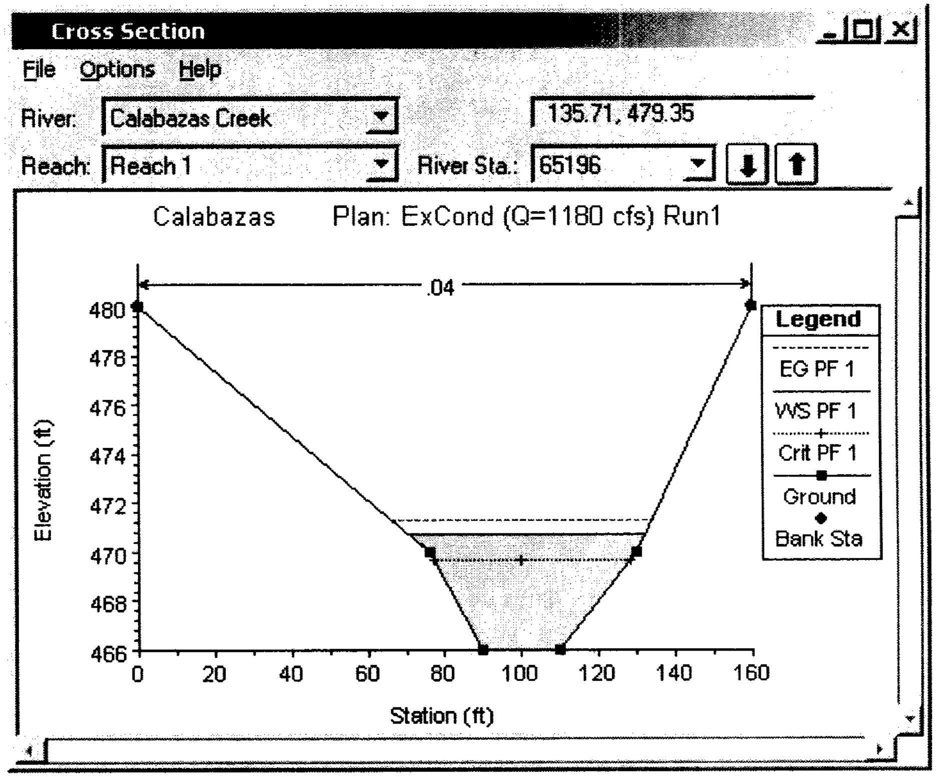
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 160 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Edit main channel Manning's n value



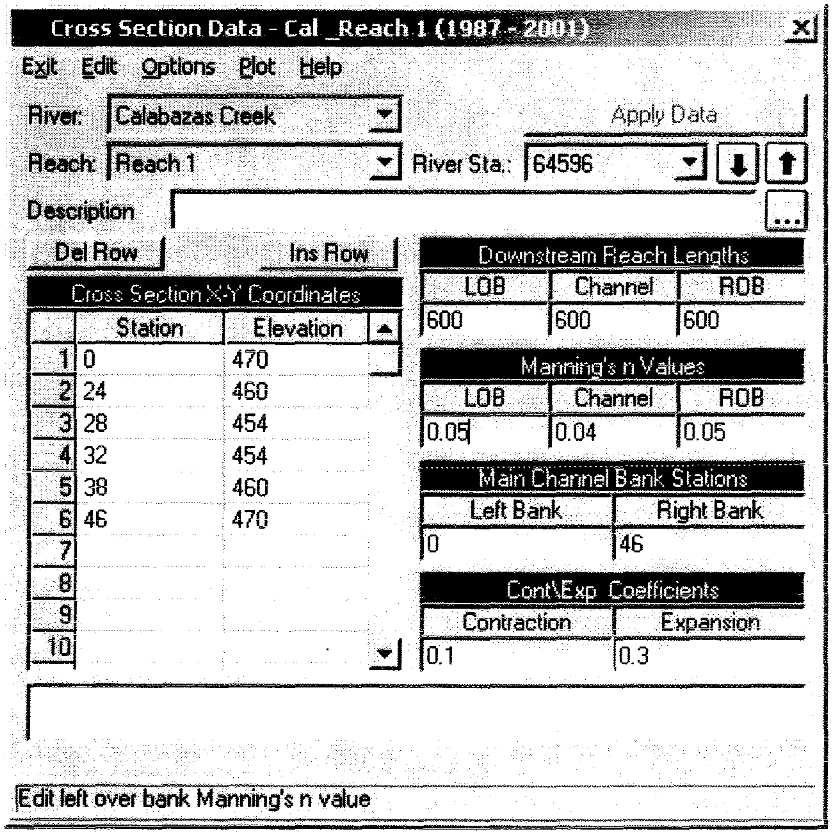
Cross Section

River: Calabazas Creek

135.71, 479.35

Reach: Reach 1

River Sta.: 65196


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 64596

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 470 |
| 2 | 24 | 460 |
| 3 | 28 | 454 |
| 4 | 32 | 454 |
| 5 | 38 | 460 |
| 6 | 46 | 470 |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 600 | 600 | 600 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

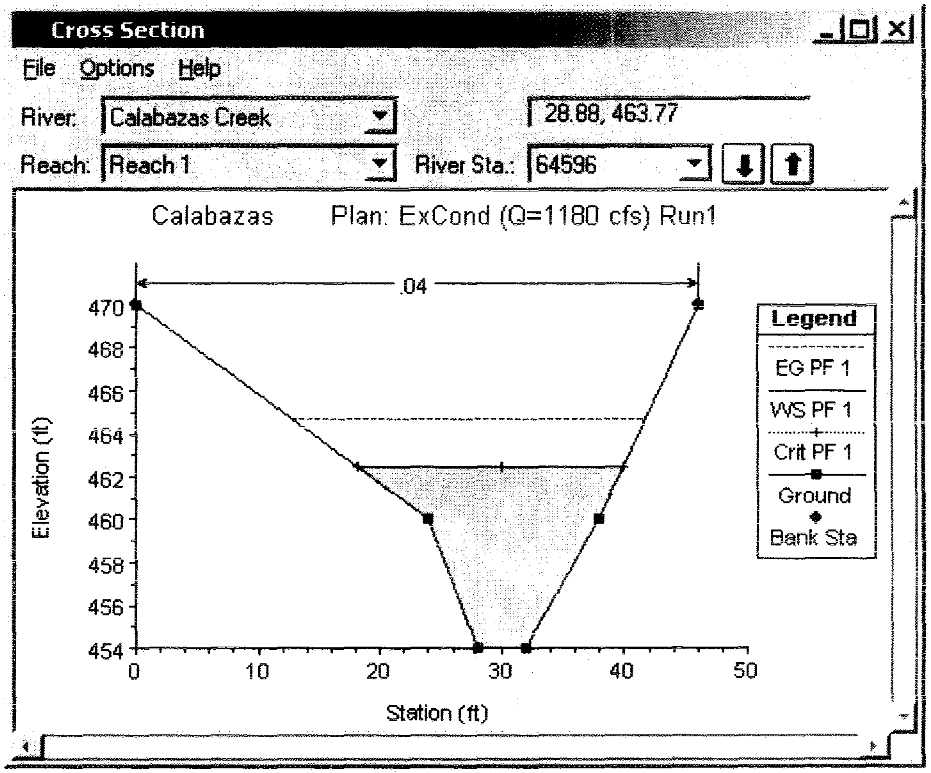
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 46 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Edit left over bank Manning's n value

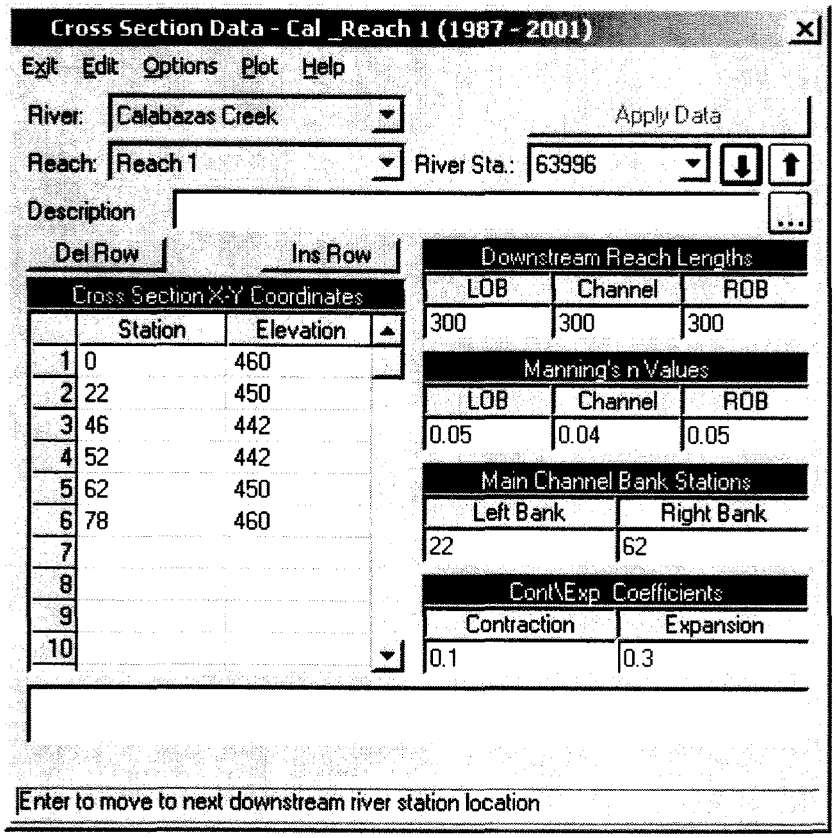


River: Calabazas Creek

Reach: Reach 1

River Sta.: 64596

28.88, 463.77



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63996

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 460 |
| 2 | 22 | 450 |
| 3 | 46 | 442 |
| 4 | 52 | 442 |
| 5 | 62 | 450 |
| 6 | 78 | 460 |
| 7 |  |  |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 300 | 300 | 300 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

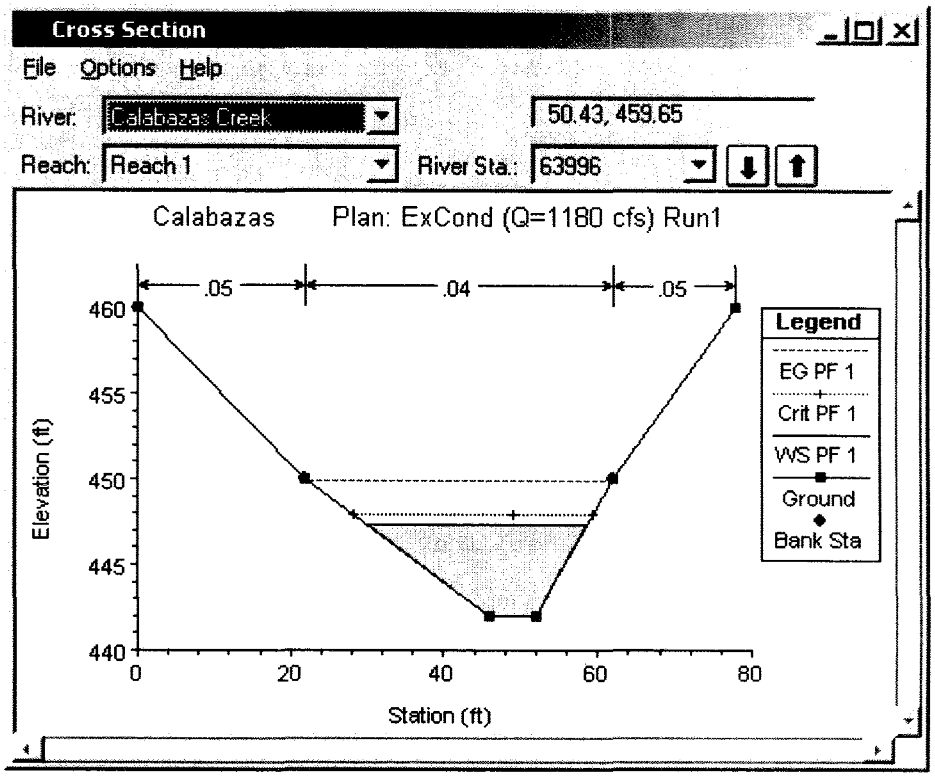
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 22 | 62 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

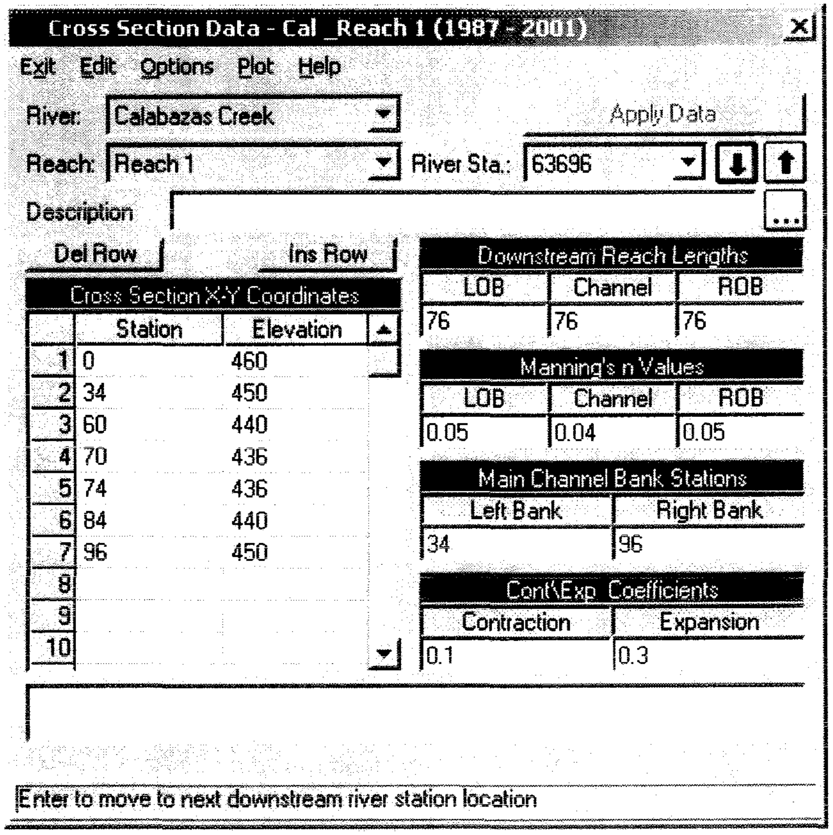


River: Calabazas Creek

Reach: Reach 1

River Sta.: 63996

50.43, 459.65



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63696

Description:

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 460 |
| 2 | 34 | 450 |
| 3 | 60 | 440 |
| 4 | 70 | 436 |
| 5 | 74 | 436 |
| 6 | 84 | 440 |
| 7 | 96 | 450 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 76 | 76 | 76 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

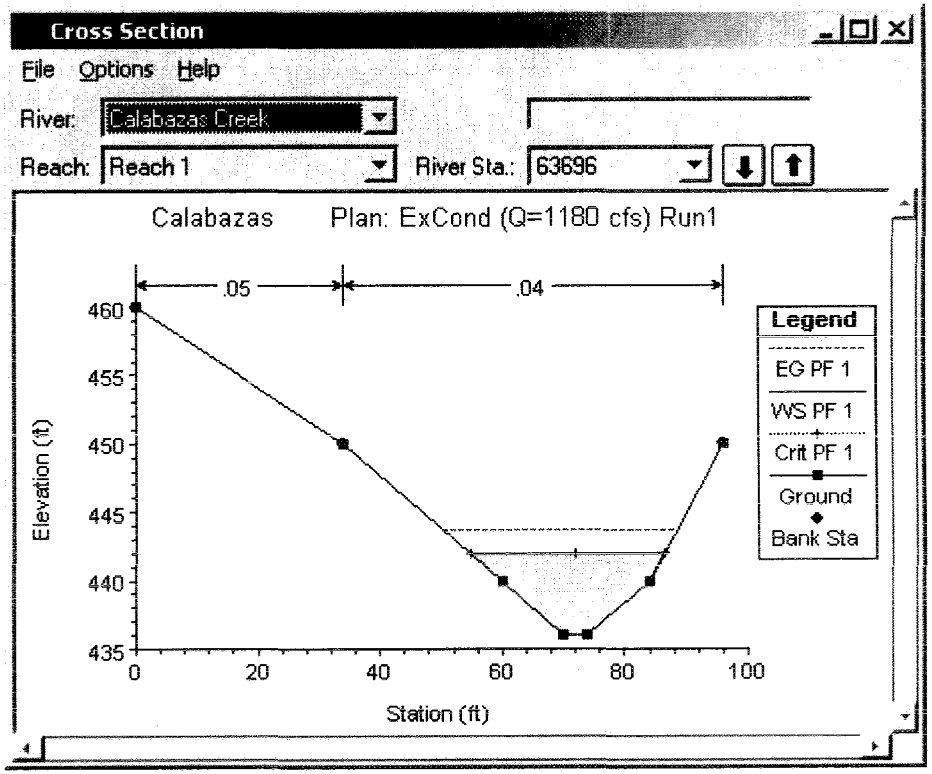
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 34 | 96 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

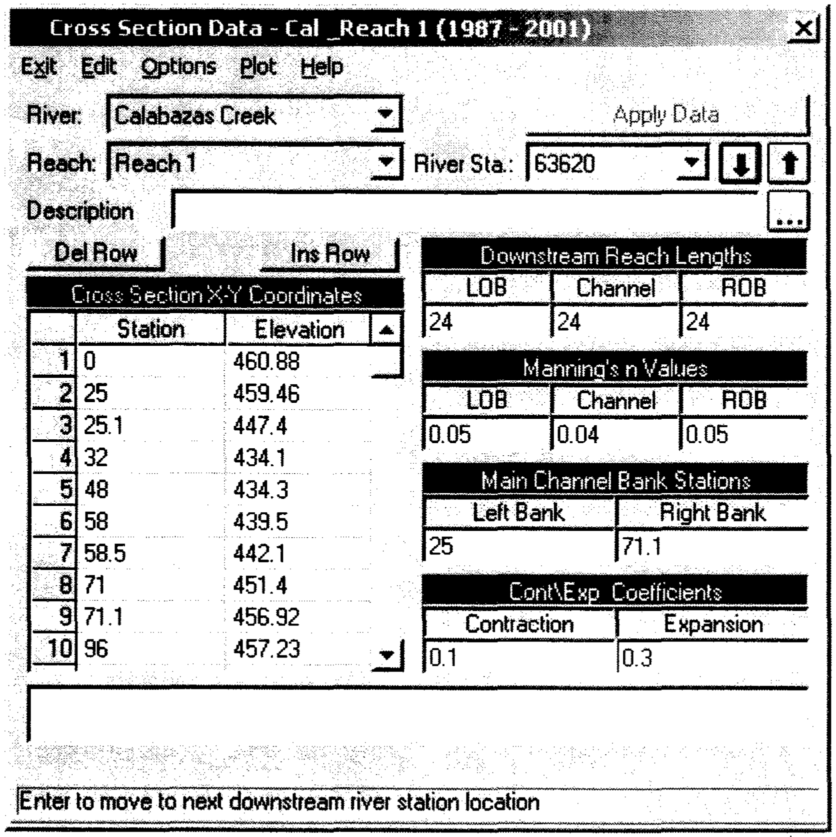
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63696



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63620

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 460.88 |
| 2 | 25 | 459.46 |
| 3 | 25.1 | 447.4 |
| 4 | 32 | 434.1 |
| 5 | 48 | 434.3 |
| 6 | 58 | 439.5 |
| 7 | 58.5 | 442.1 |
| 8 | 71 | 451.4 |
| 9 | 71.1 | 456.92 |
| 10 | 96 | 457.23 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 24 | 24 | 24 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

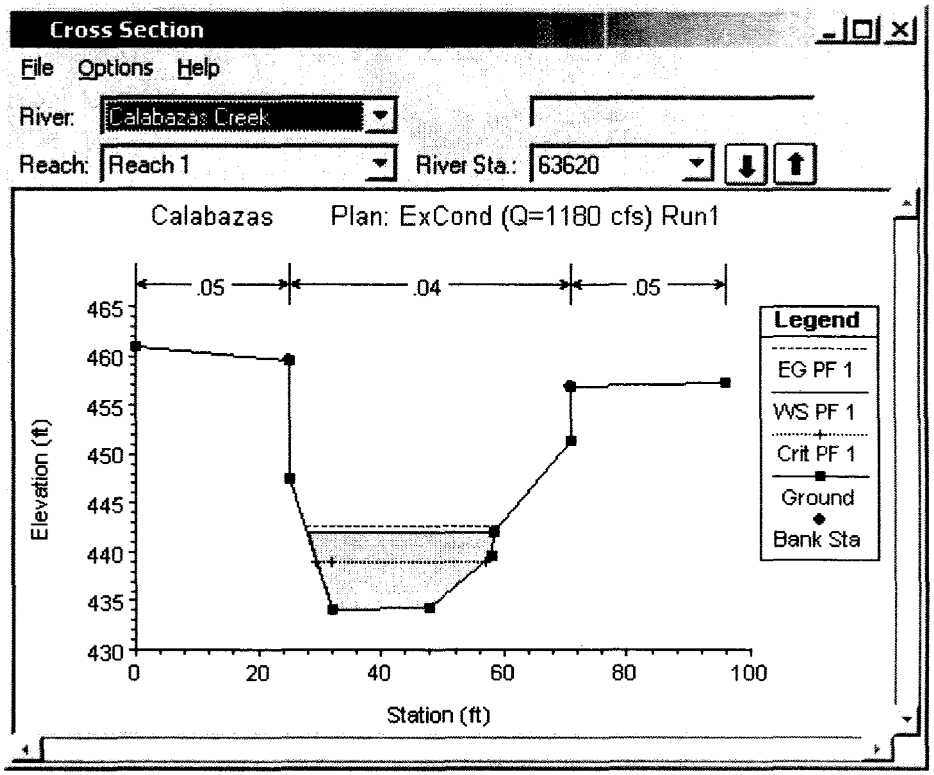
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 25 | 71.1 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

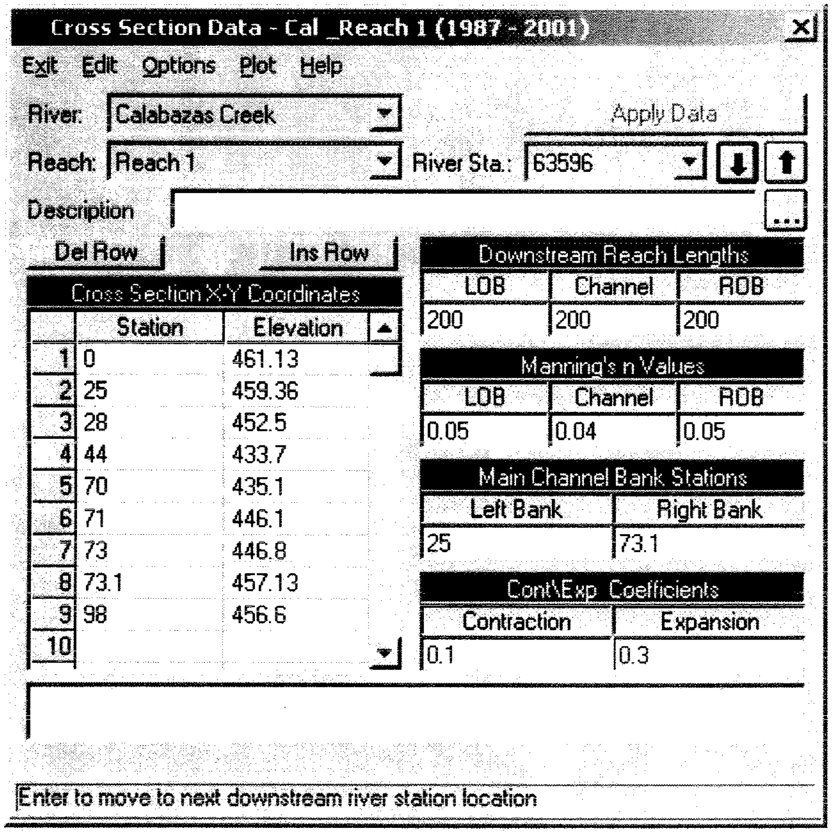
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63620



River: Calabazas Creek

Reach: Reach 1 River Sta.: 63596

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 461.13 |
| 2 | 25 | 459.36 |
| 3 | 28 | 452.5 |
| 4 | 44 | 433.7 |
| 5 | 70 | 435.1 |
| 6 | 71 | 446.1 |
| 7 | 73 | 446.8 |
| 8 | 73.1 | 457.13 |
| 9 | 98 | 456.6 |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 200 | 200 | 200 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

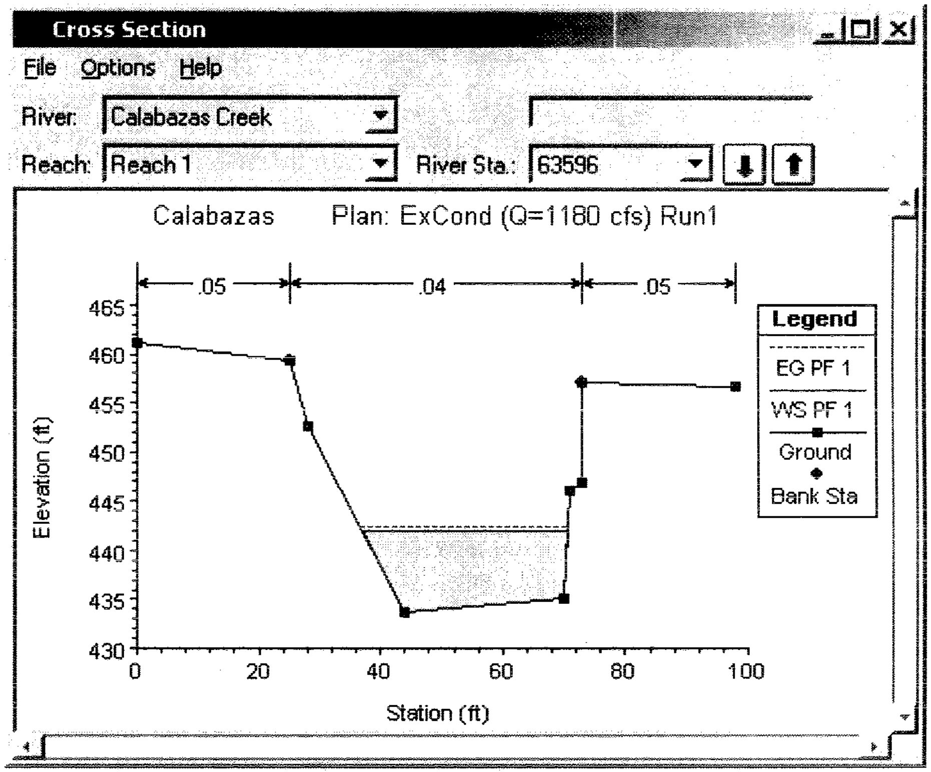
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 25 | 73.1 |

Cont\Exp Coefficients

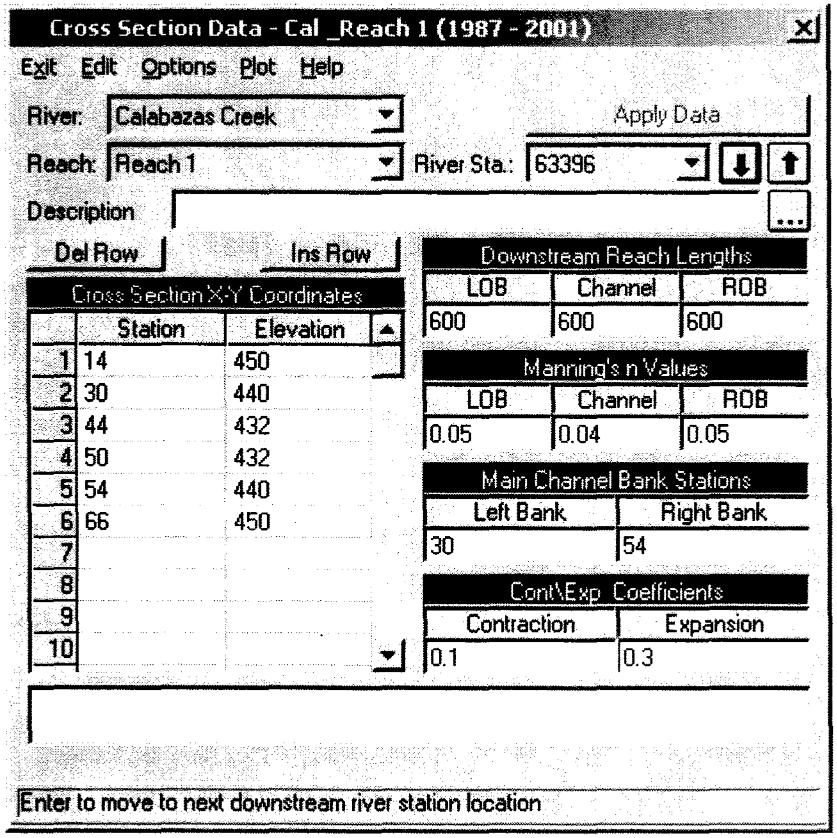
| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1 River Sta.: 63596



River: Calabazas Creek

Reach: Reach 1

River Sta.: 63396

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 14 | 450 |
| 2 | 30 | 440 |
| 3 | 44 | 432 |
| 4 | 50 | 432 |
| 5 | 54 | 440 |
| 6 | 66 | 450 |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 600 | 600 | 600 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

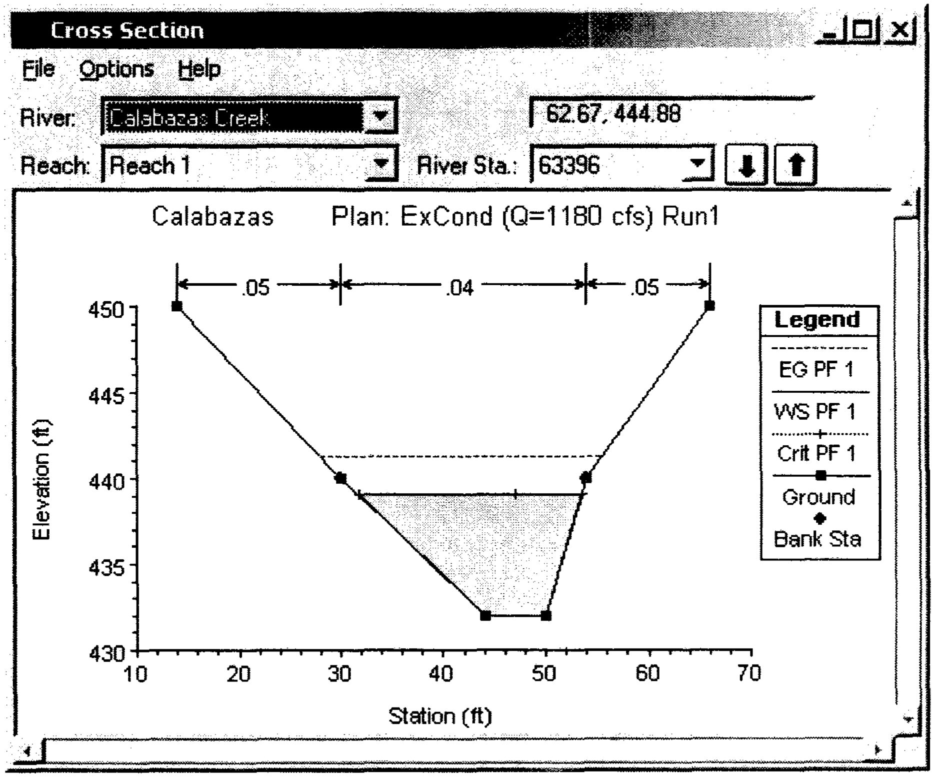
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 30 | 54 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

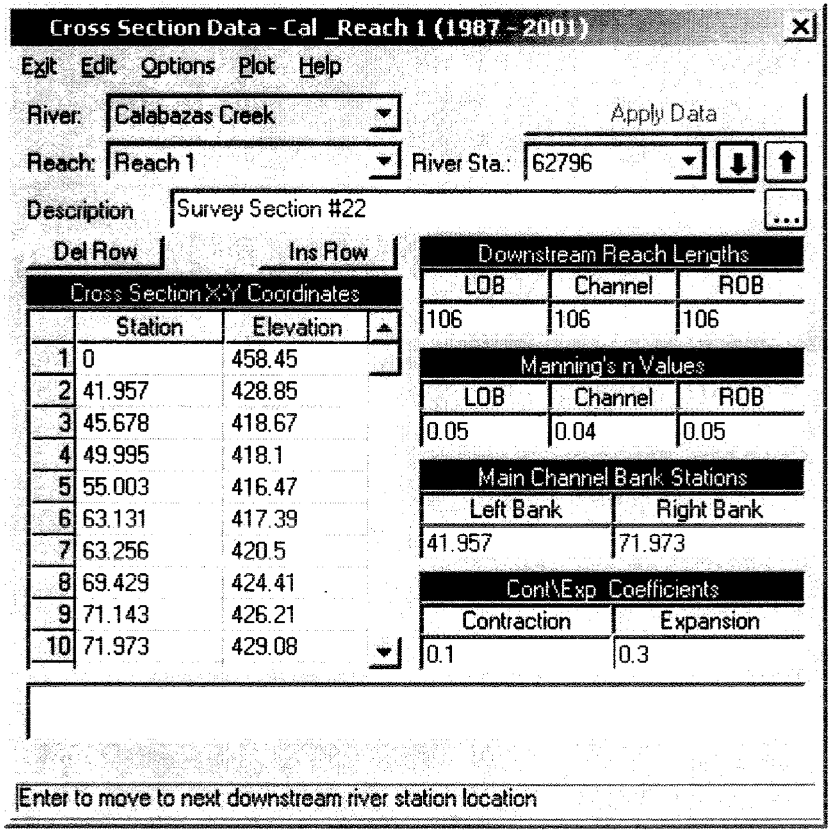


River: Calabazas Creek

Reach: Reach 1

River Sta.: 63396

62.67, 444.88



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62796

Description: Survey Section #22

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 458.45 |
| 2 | 41.957 | 428.85 |
| 3 | 45.678 | 418.67 |
| 4 | 49.995 | 418.1 |
| 5 | 55.003 | 416.47 |
| 6 | 63.131 | 417.39 |
| 7 | 63.256 | 420.5 |
| 8 | 69.429 | 424.41 |
| 9 | 71.143 | 426.21 |
| 10 | 71.973 | 429.08 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 106 | 106 | 106 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

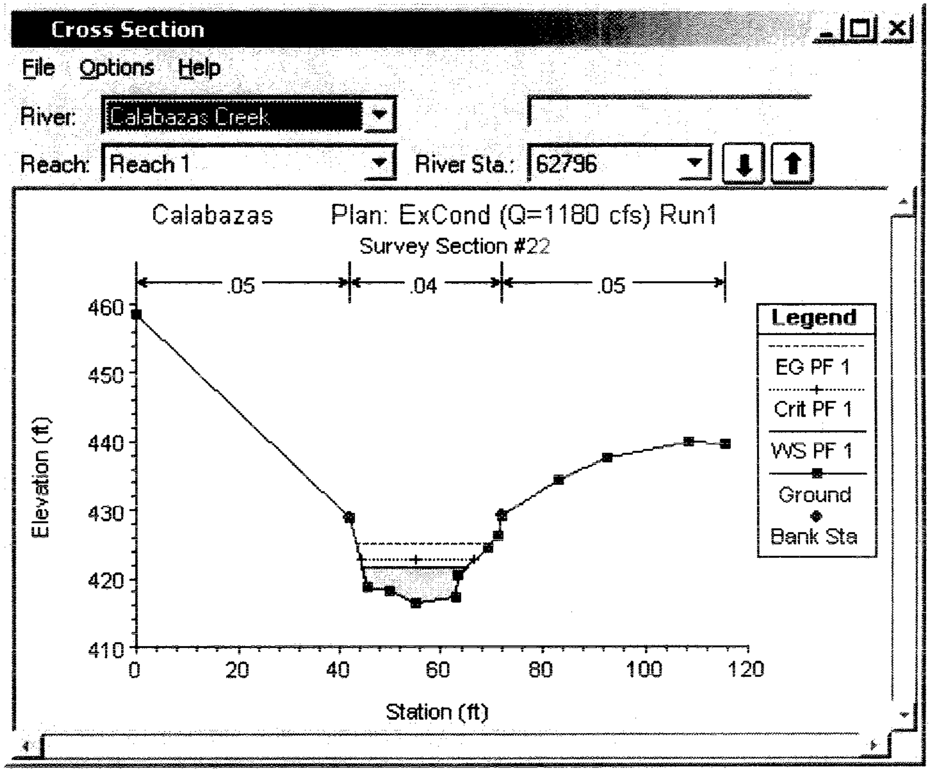
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 41.957 | 71.973 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

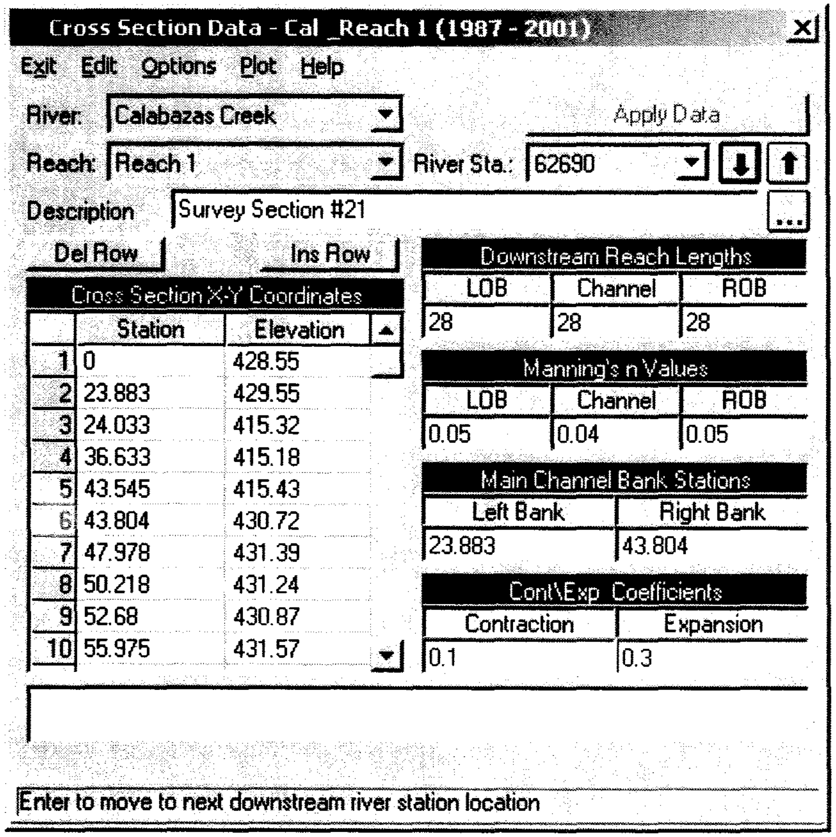


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62796



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62690

Description: Survey Section #21

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 428.55 |
| 2 | 23.883 | 429.55 |
| 3 | 24.033 | 415.32 |
| 4 | 36.633 | 415.18 |
| 5 | 43.545 | 415.43 |
| 6 | 43.804 | 430.72 |
| 7 | 47.978 | 431.39 |
| 8 | 50.218 | 431.24 |
| 9 | 52.68 | 430.87 |
| 10 | 55.975 | 431.57 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 28 | 28 | 28 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

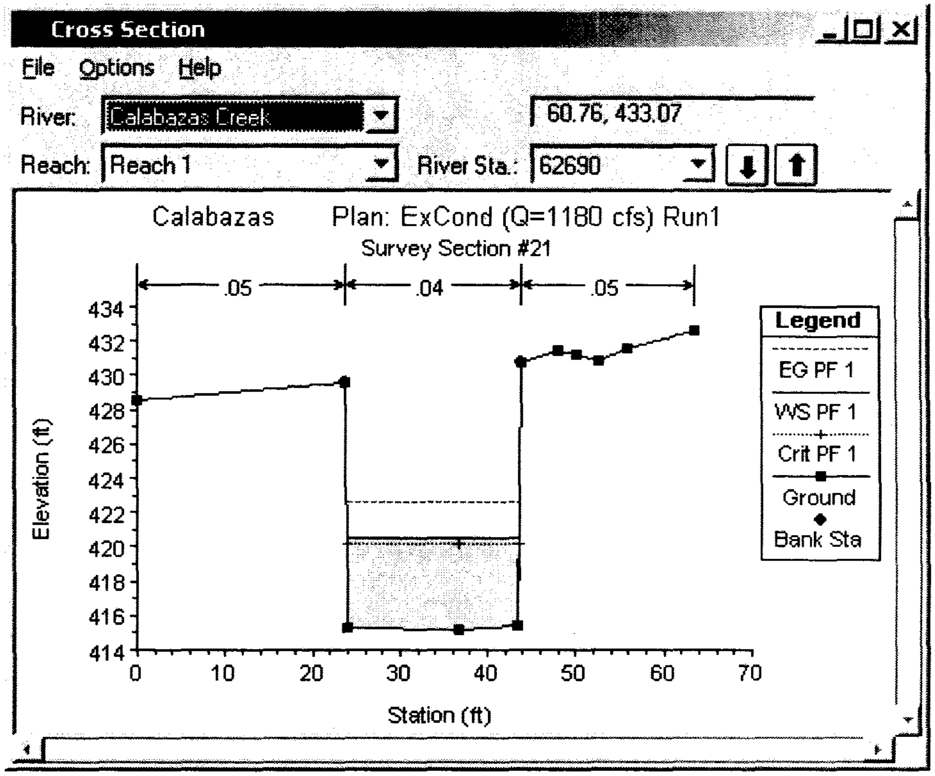
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 23.883 | 43.804 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



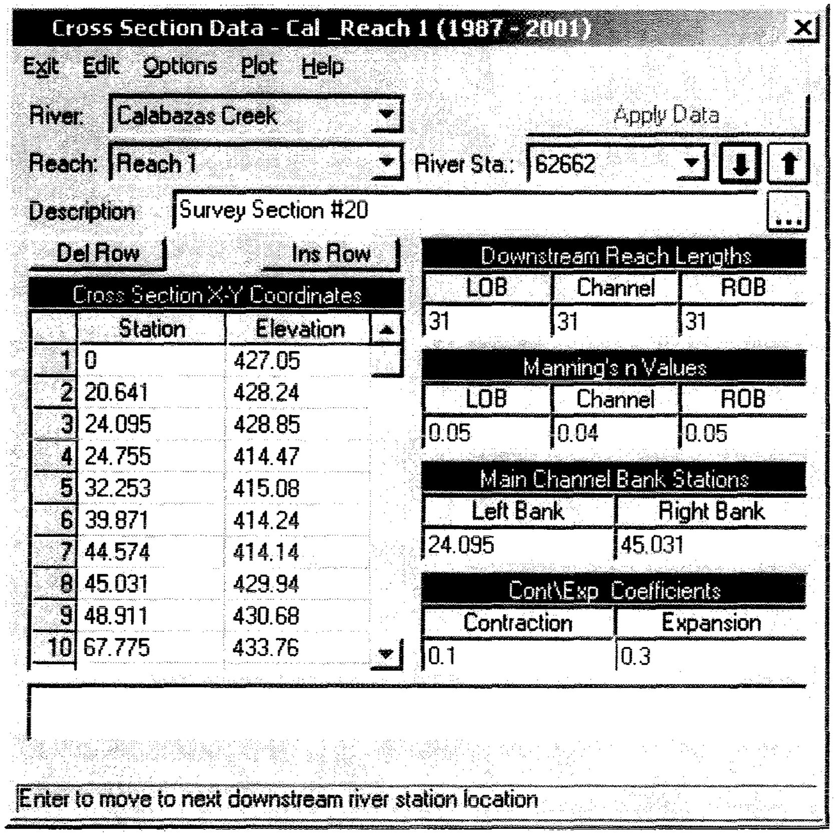
Cross Section

River: Calabazas Creek

60.76, 433.07

Reach: Reach 1

River Sta.: 62690


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62662

Description: Survey Section #20

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 427.05 |
| 2 | 20.641 | 428.24 |
| 3 | 24.095 | 428.85 |
| 4 | 24.755 | 414.47 |
| 5 | 32.253 | 415.08 |
| 6 | 39.871 | 414.24 |
| 7 | 44.574 | 414.14 |
| 8 | 45.031 | 429.94 |
| 9 | 48.911 | 430.68 |
| 10 | 67.775 | 433.76 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 31 | 31 | 31 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

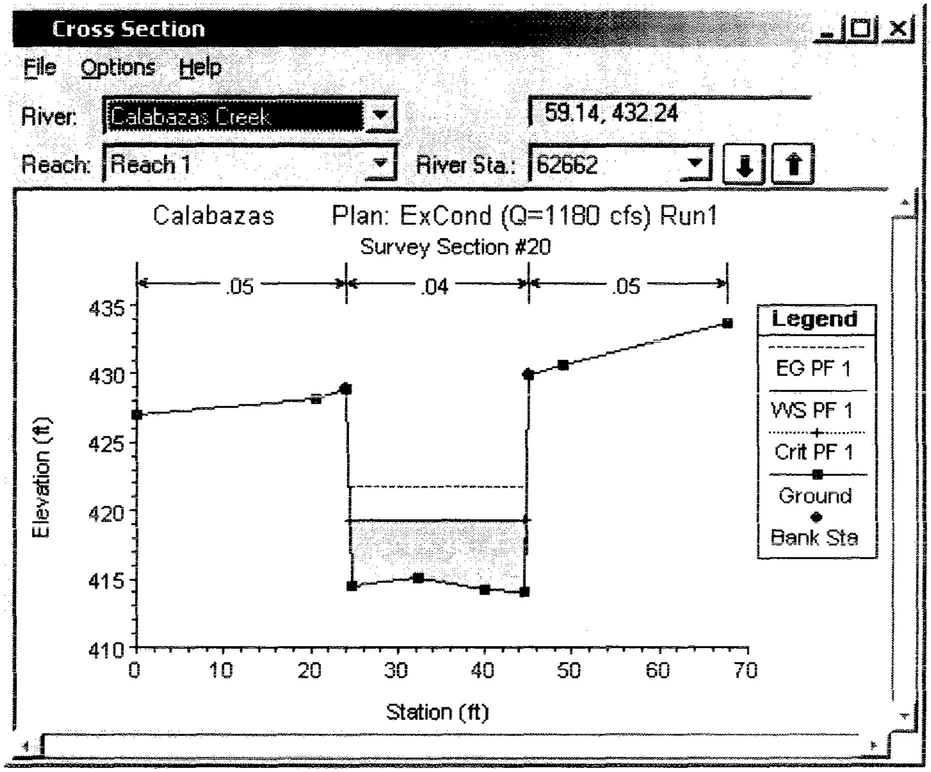
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 24.095 | 45.031 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

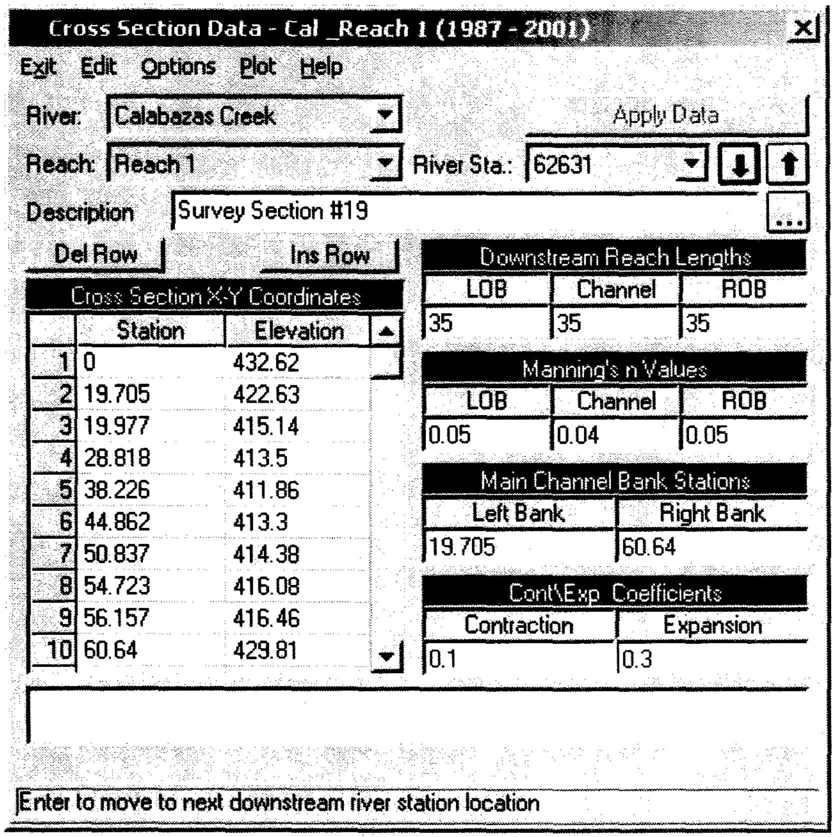


River: Calabazas Creek

59.14, 432.24

Reach: Reach 1

River Sta.: 62662



River: Calabazas Creek
Reach: Reach 1
River Sta.: 62631
Description: Survey Section #19

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 432.62 |
| 2 | 19.705 | 422.63 |
| 3 | 19.977 | 415.14 |
| 4 | 28.818 | 413.5 |
| 5 | 38.226 | 411.86 |
| 6 | 44.862 | 413.3 |
| 7 | 50.837 | 414.38 |
| 8 | 54.723 | 416.08 |
| 9 | 56.157 | 416.46 |
| 10 | 60.64 | 429.81 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 35 | 35 | 35 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

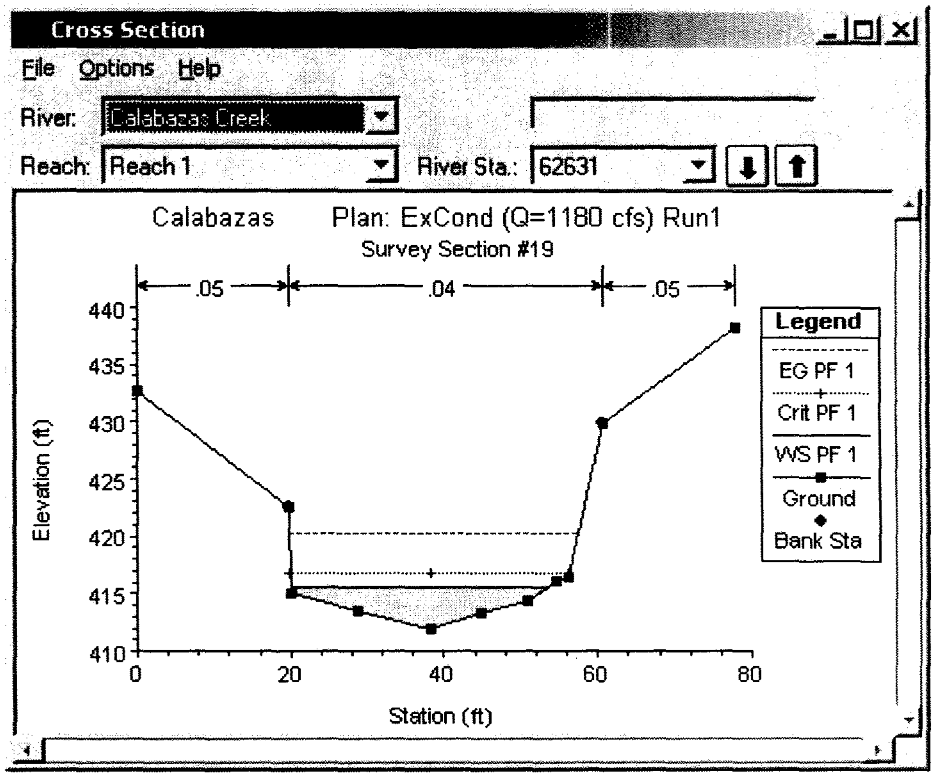
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 19.705 | 60.64 |

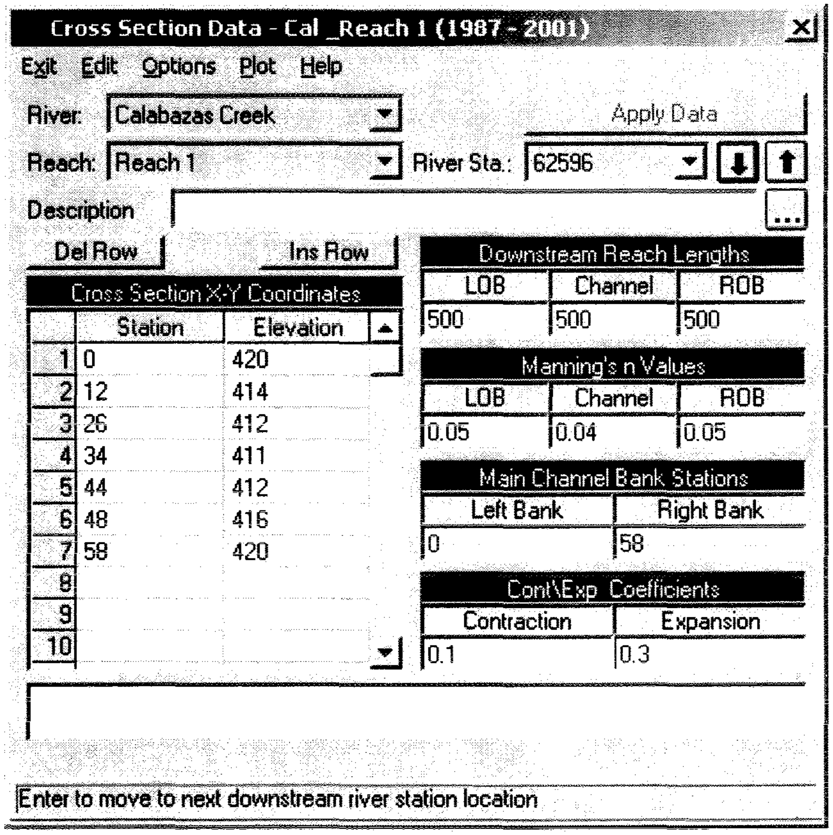
Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



River: Calabazas Creek
Reach: Reach 1
River Sta.: 62631



River: Calabazas Creek

Reach: Reach 1

River Sta.: 62596

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 420 |
| 2 | 12 | 414 |
| 3 | 26 | 412 |
| 4 | 34 | 411 |
| 5 | 44 | 412 |
| 6 | 48 | 416 |
| 7 | 58 | 420 |
| 8 | | |
| 9 | | |
| 10 | | |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 500 | 500 | 500 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

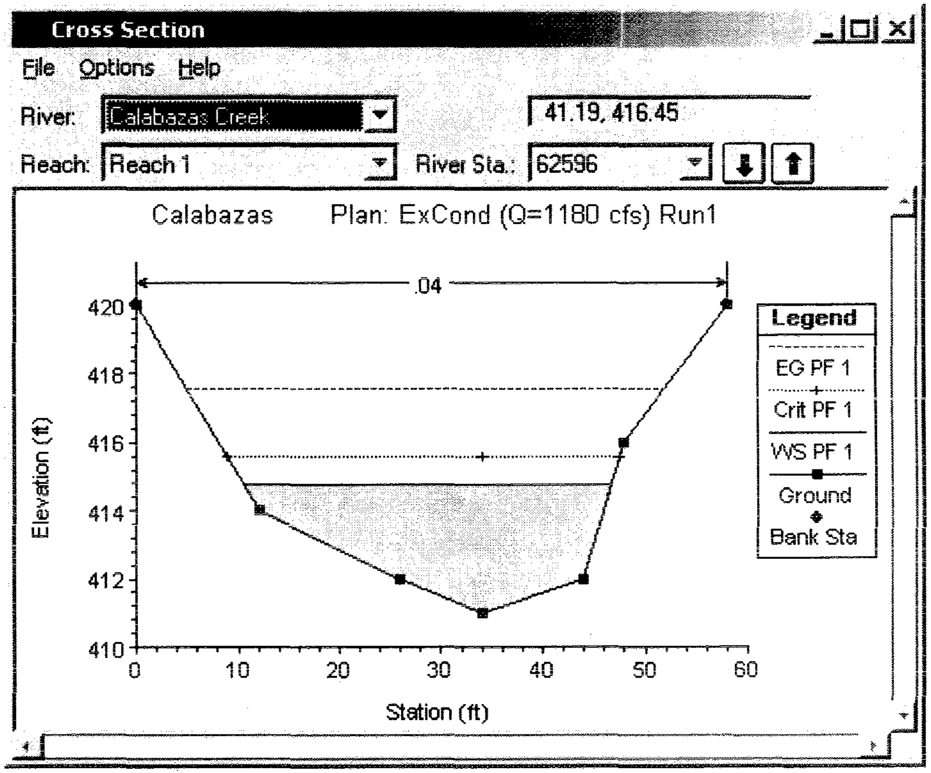
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 0 | 58 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

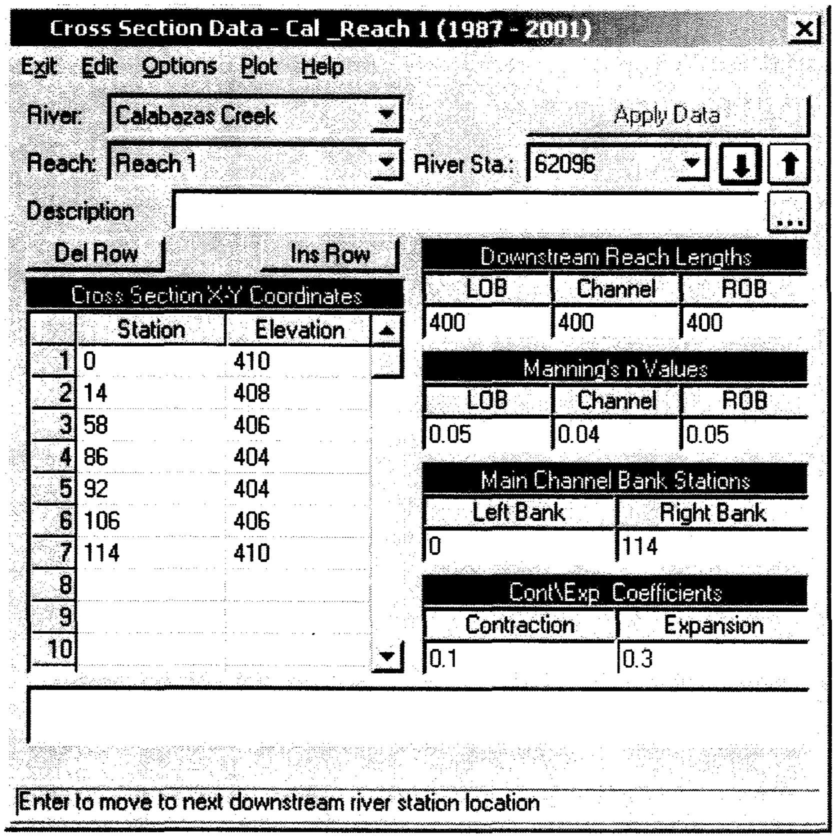


River: Calabazas Creek

41.19, 416.45

Reach: Reach 1

River Sta.: 62596



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62096

Description

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 410 |
| 2 | 14 | 408 |
| 3 | 58 | 406 |
| 4 | 86 | 404 |
| 5 | 92 | 404 |
| 6 | 106 | 406 |
| 7 | 114 | 410 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 400 | 400 | 400 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

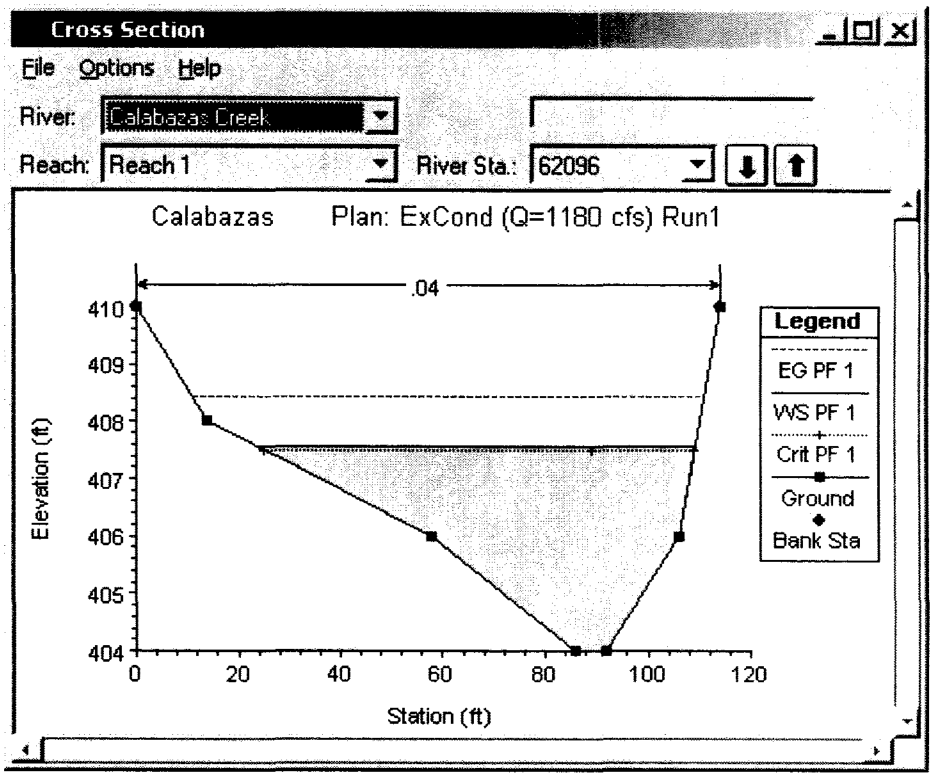
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 114 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

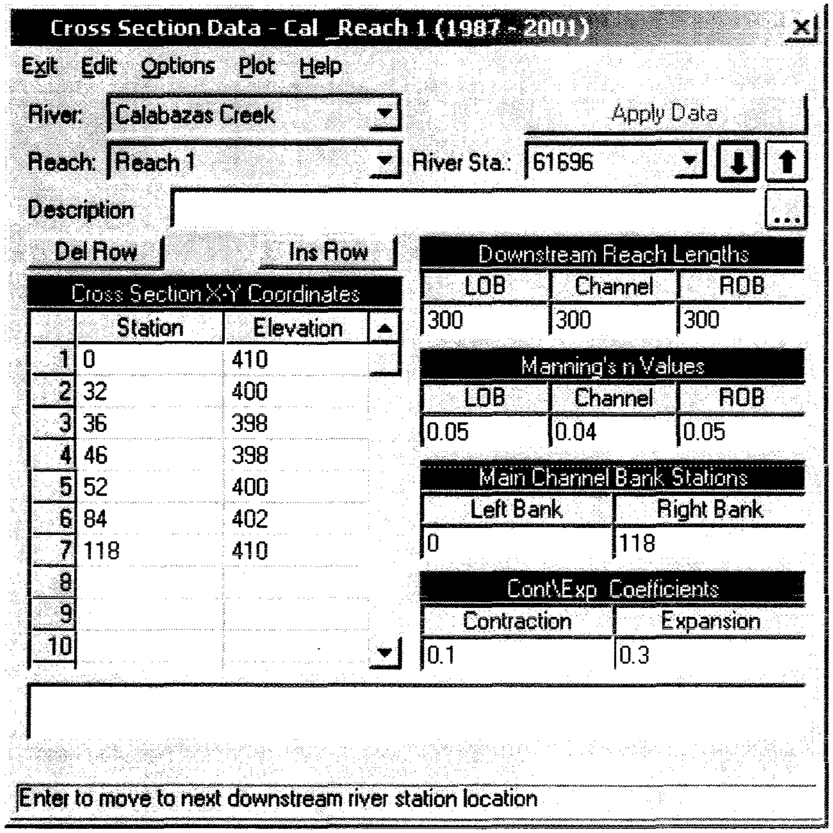


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 62096



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 61696

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 410 |
| 2 | 32 | 400 |
| 3 | 36 | 398 |
| 4 | 46 | 398 |
| 5 | 52 | 400 |
| 6 | 84 | 402 |
| 7 | 118 | 410 |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 300 | 300 | 300 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

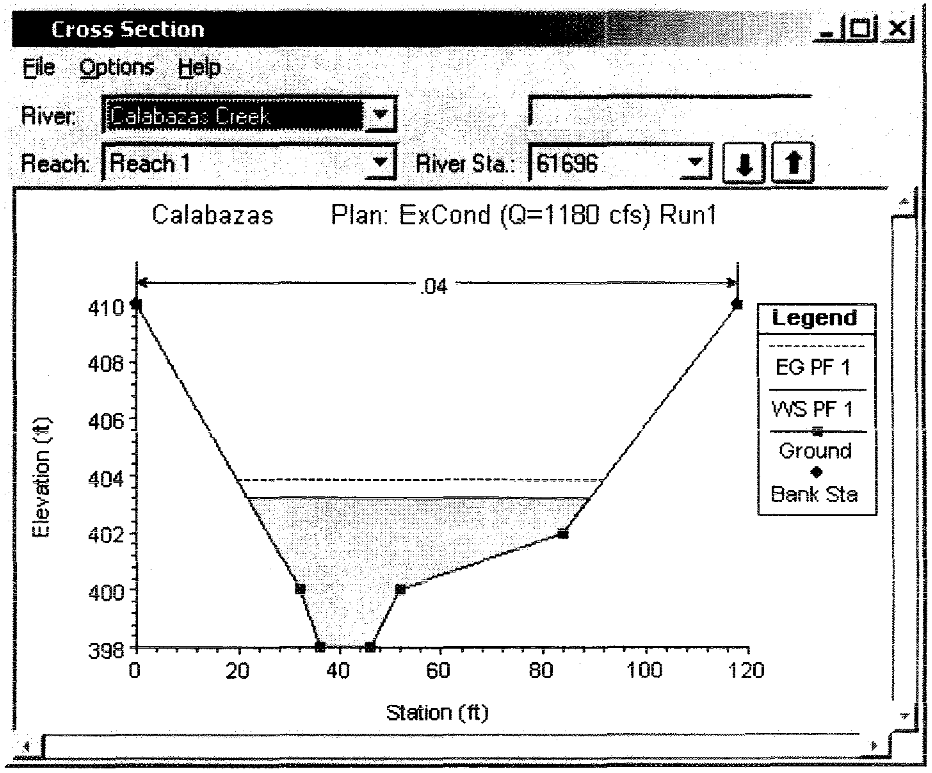
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 118 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



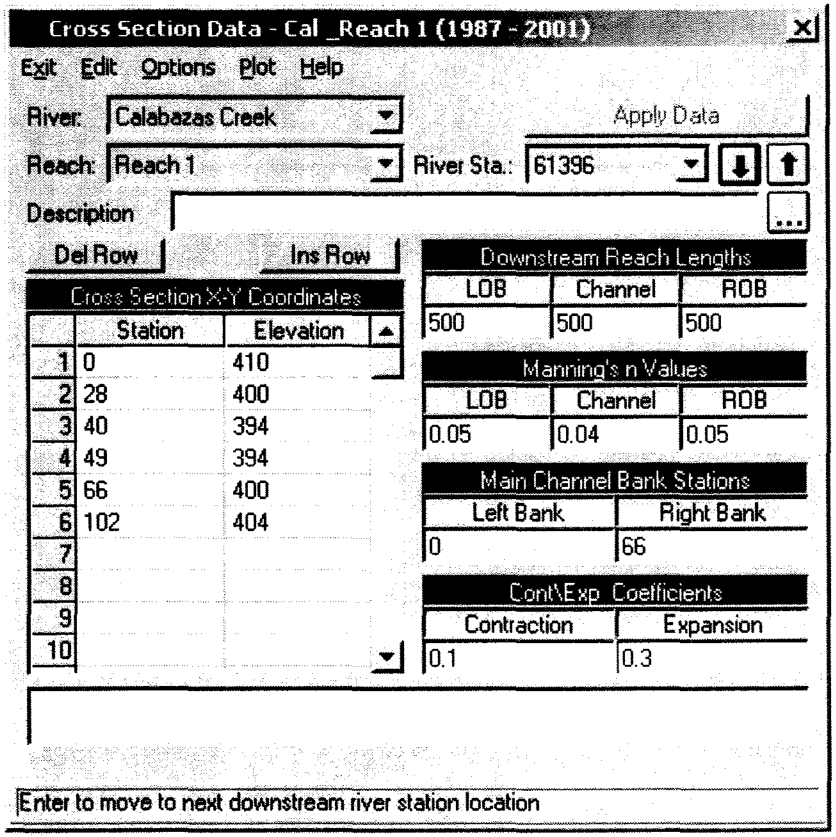
**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 61696

Calabazas Plan: ExCond (Q=1180 cfs) Run1



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 61396

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 410 |
| 2 | 28 | 400 |
| 3 | 40 | 394 |
| 4 | 49 | 394 |
| 5 | 66 | 400 |
| 6 | 102 | 404 |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 500 | 500 | 500 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

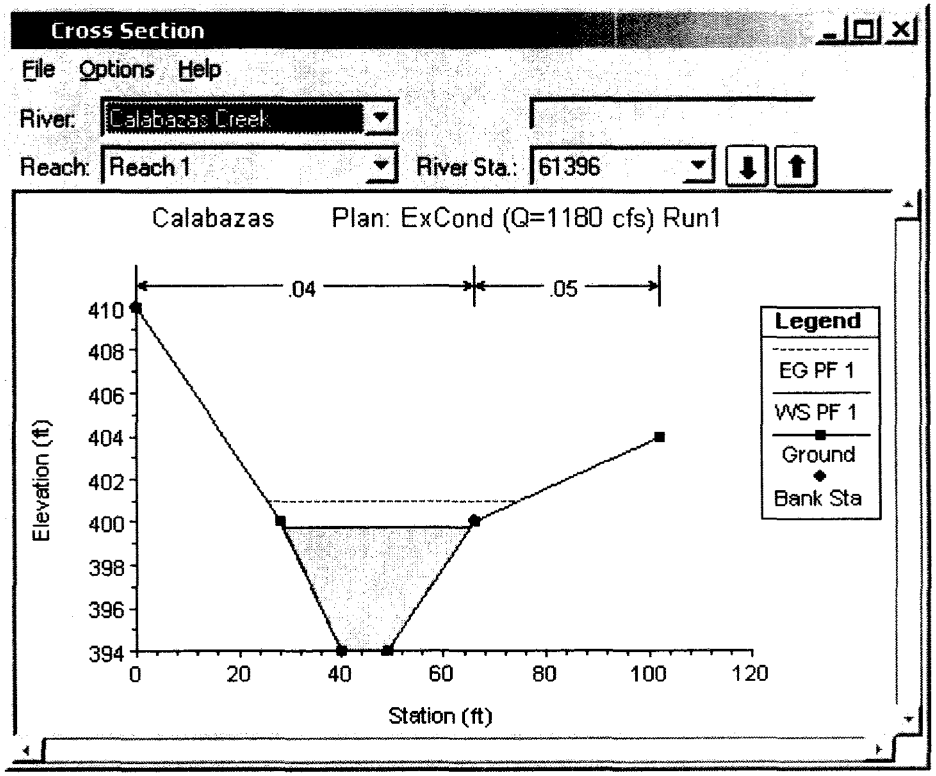
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 66 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

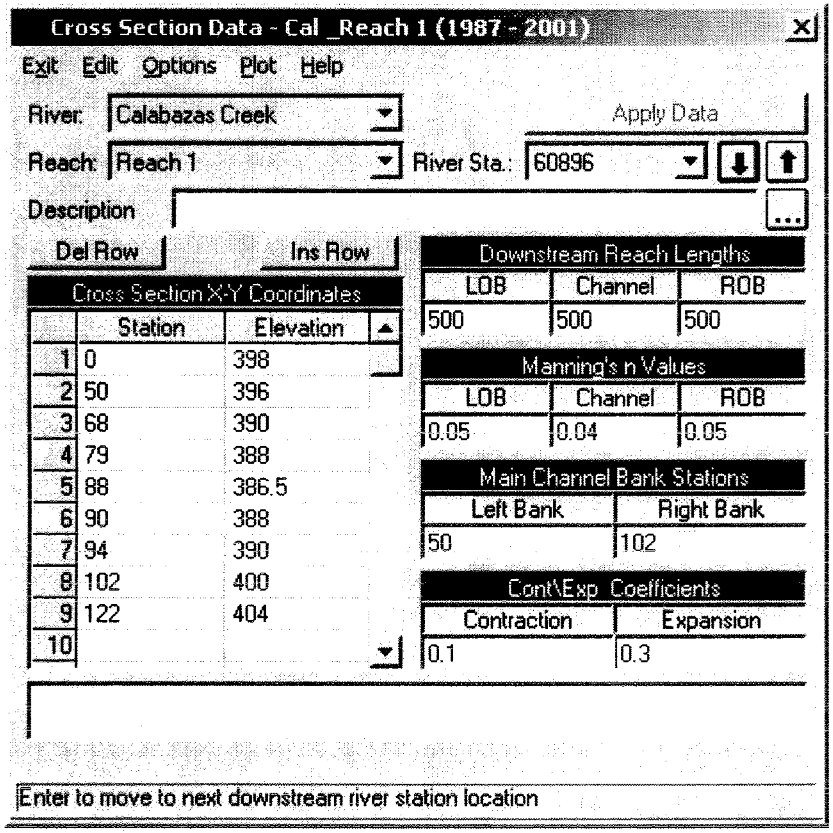
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 61396



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 60896

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 398 |
| 2 | 50 | 396 |
| 3 | 68 | 390 |
| 4 | 79 | 388 |
| 5 | 88 | 386.5 |
| 6 | 90 | 388 |
| 7 | 94 | 390 |
| 8 | 102 | 400 |
| 9 | 122 | 404 |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 500 | 500 | 500 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

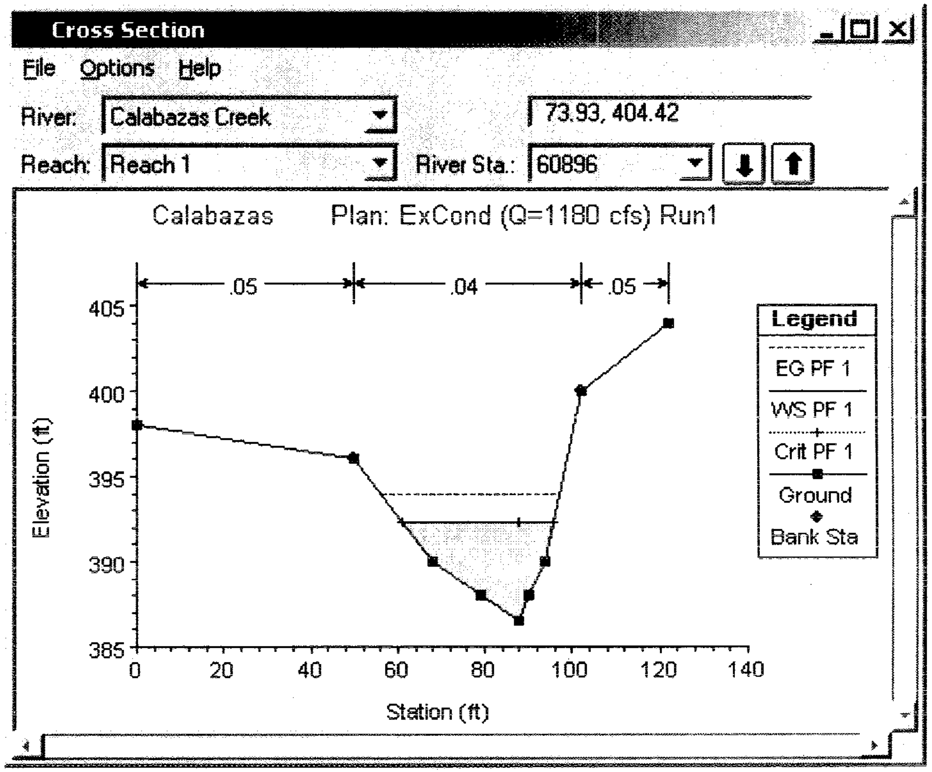
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 50 | 102 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



Cross Section

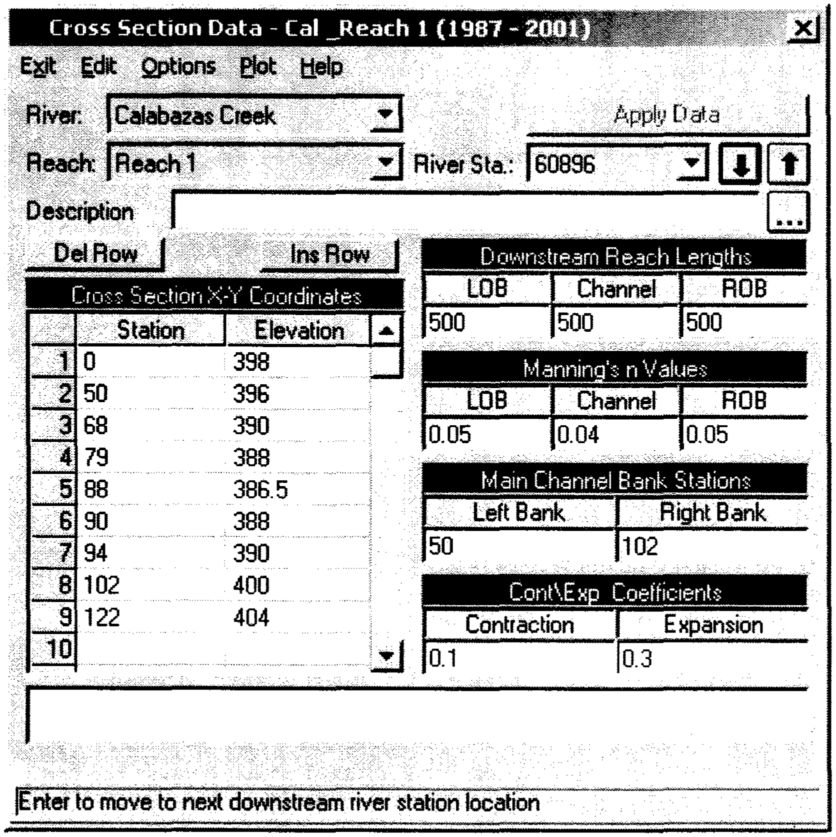
River: Calabazas Creek

Reach: Reach 1

River Sta.: 60896

73.93, 404.42

Calabazas Plan: ExCond (Q=1180 cfs) Run1



River: Calabazas Creek

Reach: Reach 1

River Sta.: 60896

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 398 |
| 2 | 50 | 396 |
| 3 | 68 | 390 |
| 4 | 79 | 388 |
| 5 | 88 | 386.5 |
| 6 | 90 | 388 |
| 7 | 94 | 390 |
| 8 | 102 | 400 |
| 9 | 122 | 404 |
| 10 | | |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 500 | 500 | 500 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

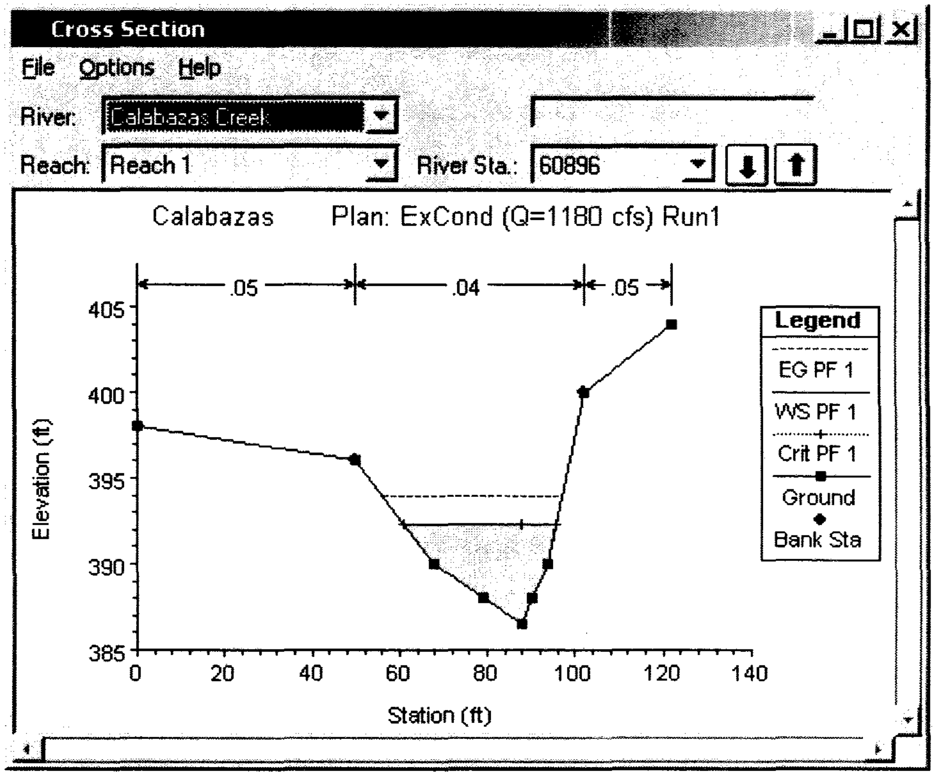
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 50 | 102 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

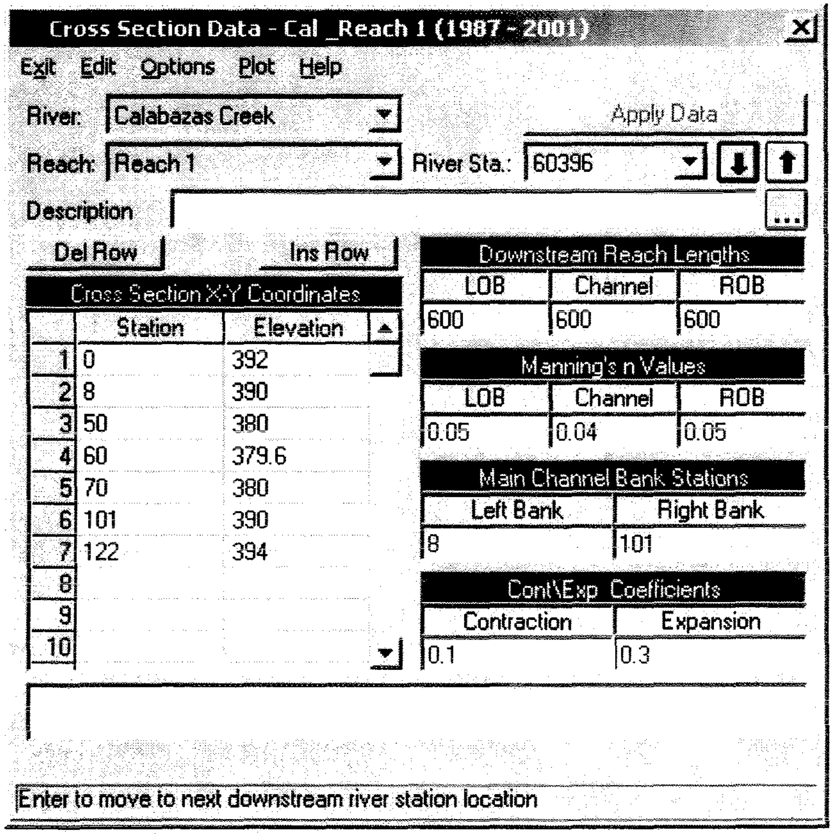


River: Calabazas Creek

Reach: Reach 1

River Sta.: 60896

Calabazas Plan: ExCond (Q=1180 cfs) Run1



River: Calabazas Creek

Reach: Reach 1

River Sta.: 60396

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 392 |
| 2 | 8 | 390 |
| 3 | 50 | 380 |
| 4 | 60 | 379.6 |
| 5 | 70 | 380 |
| 6 | 101 | 390 |
| 7 | 122 | 394 |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 600 | 600 | 600 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

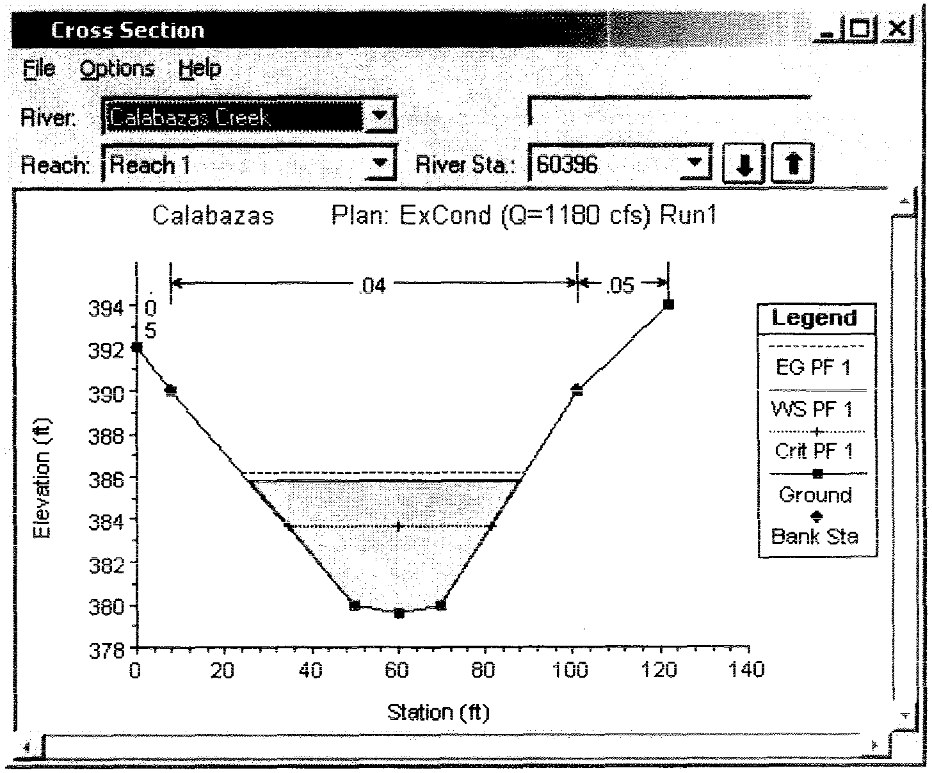
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 8 | 101 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

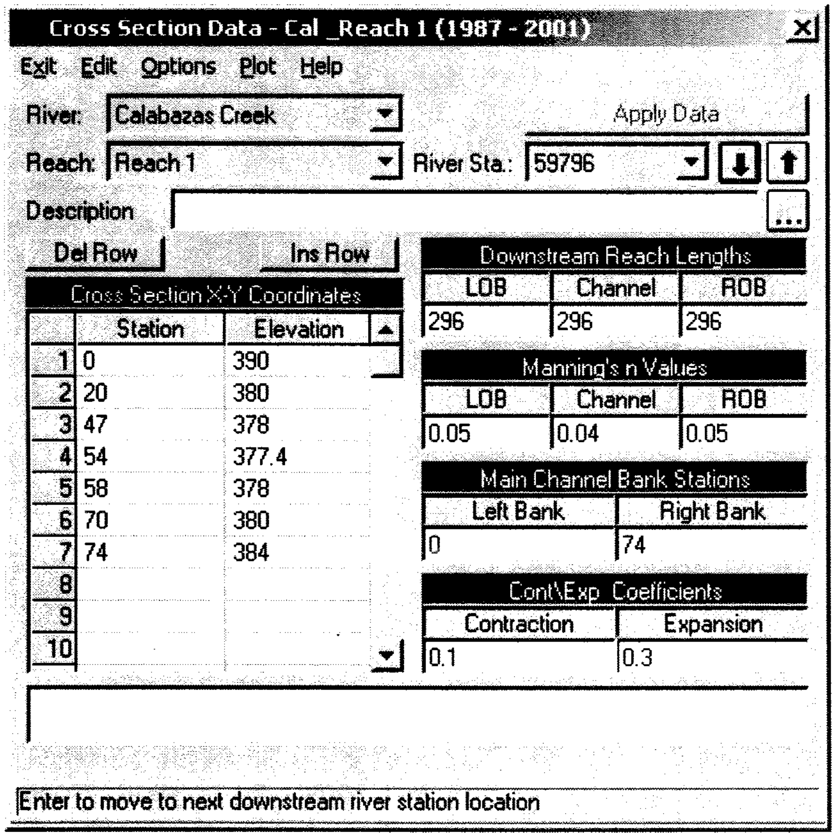
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 60396



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59796

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 390 |
| 2 | 20 | 380 |
| 3 | 47 | 378 |
| 4 | 54 | 377.4 |
| 5 | 58 | 378 |
| 6 | 70 | 380 |
| 7 | 74 | 384 |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 296 | 296 | 296 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

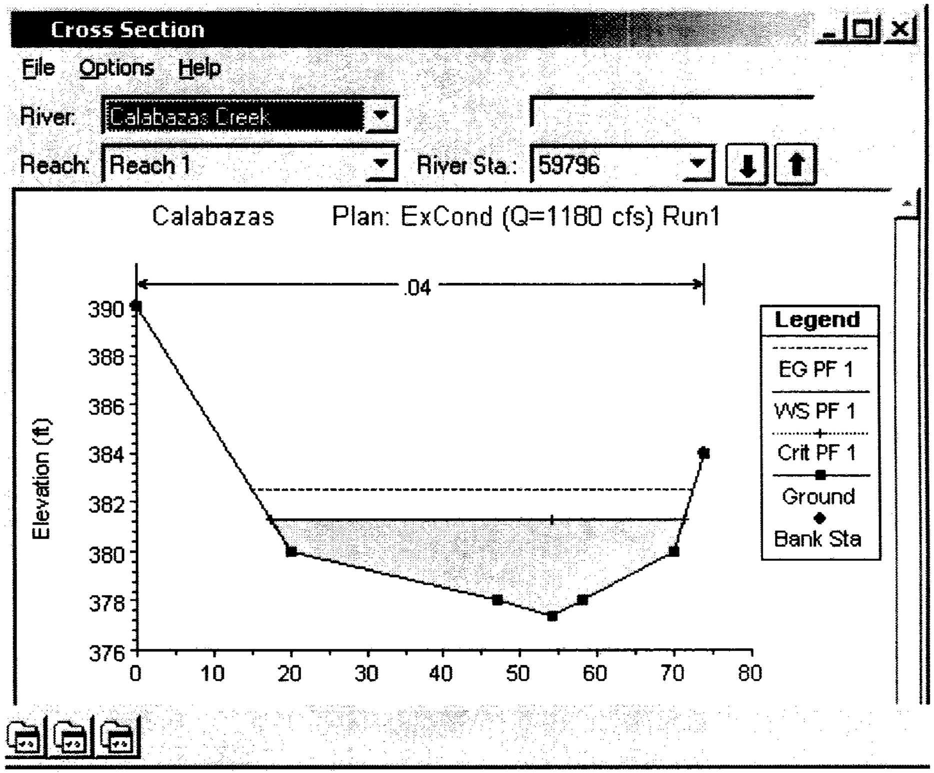
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 74 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

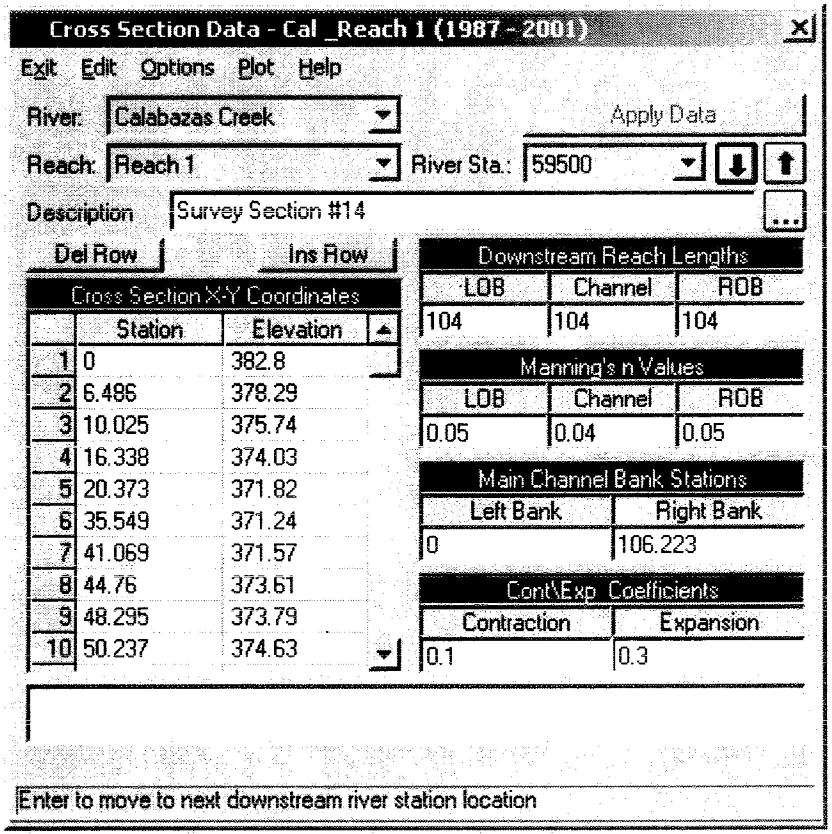
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59796



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59500

Description: Survey Section #14

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 382.8 |
| 2 | 6.486 | 378.29 |
| 3 | 10.025 | 375.74 |
| 4 | 16.338 | 374.03 |
| 5 | 20.373 | 371.82 |
| 6 | 35.549 | 371.24 |
| 7 | 41.069 | 371.57 |
| 8 | 44.76 | 373.61 |
| 9 | 48.295 | 373.79 |
| 10 | 50.237 | 374.63 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 104 | 104 | 104 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

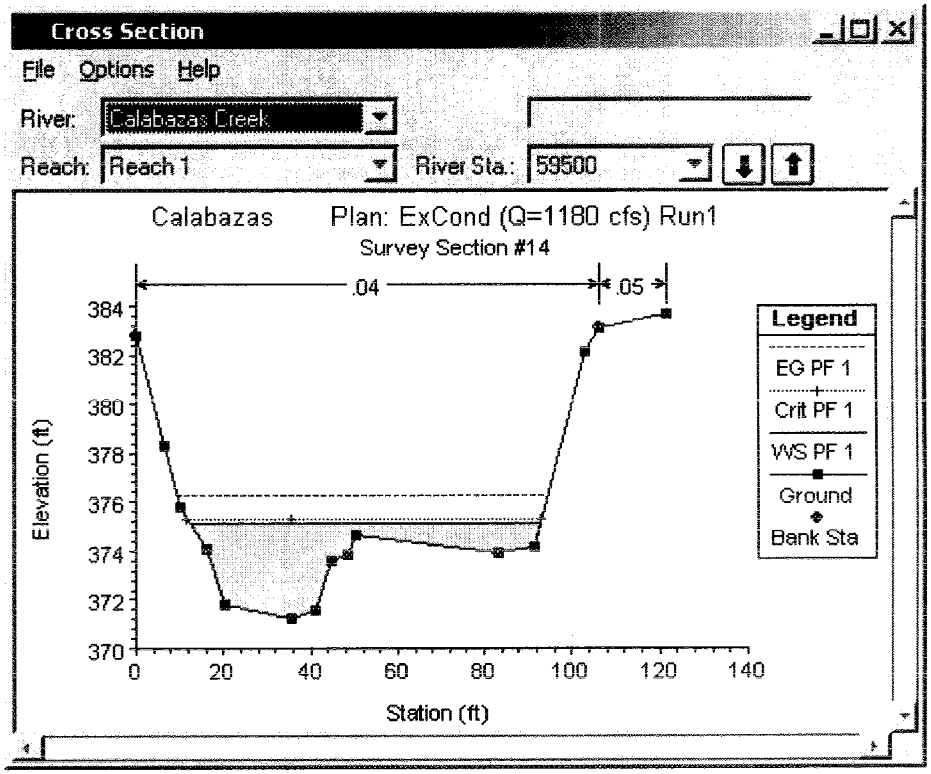
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 0 | 106.223 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

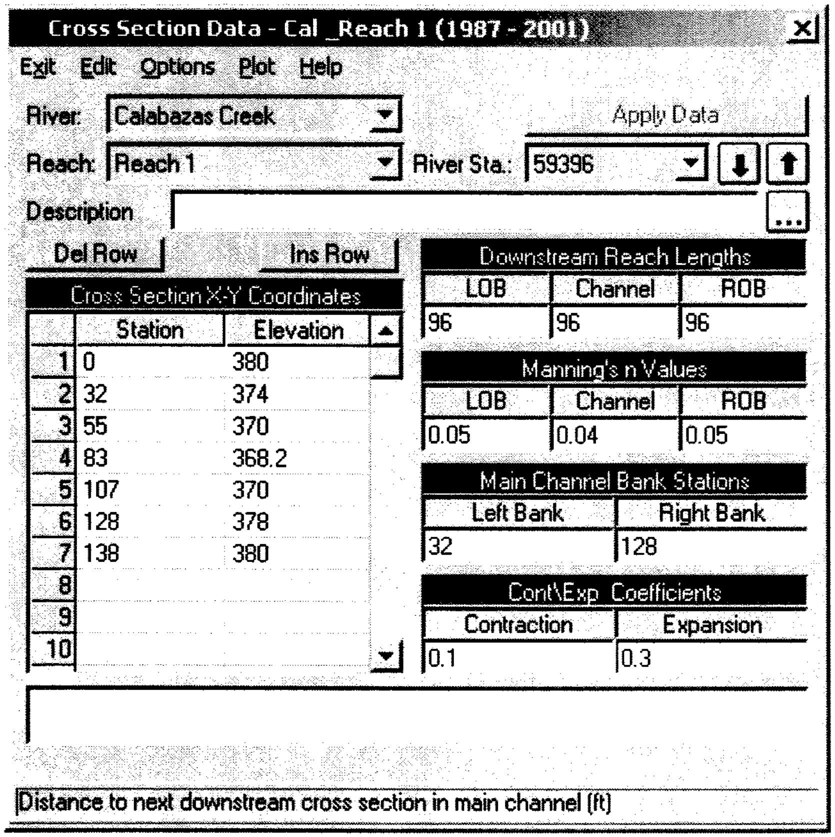
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59500



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59396

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 380 |
| 2 | 32 | 374 |
| 3 | 55 | 370 |
| 4 | 83 | 368.2 |
| 5 | 107 | 370 |
| 6 | 128 | 378 |
| 7 | 138 | 380 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 96 | 96 | 96 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

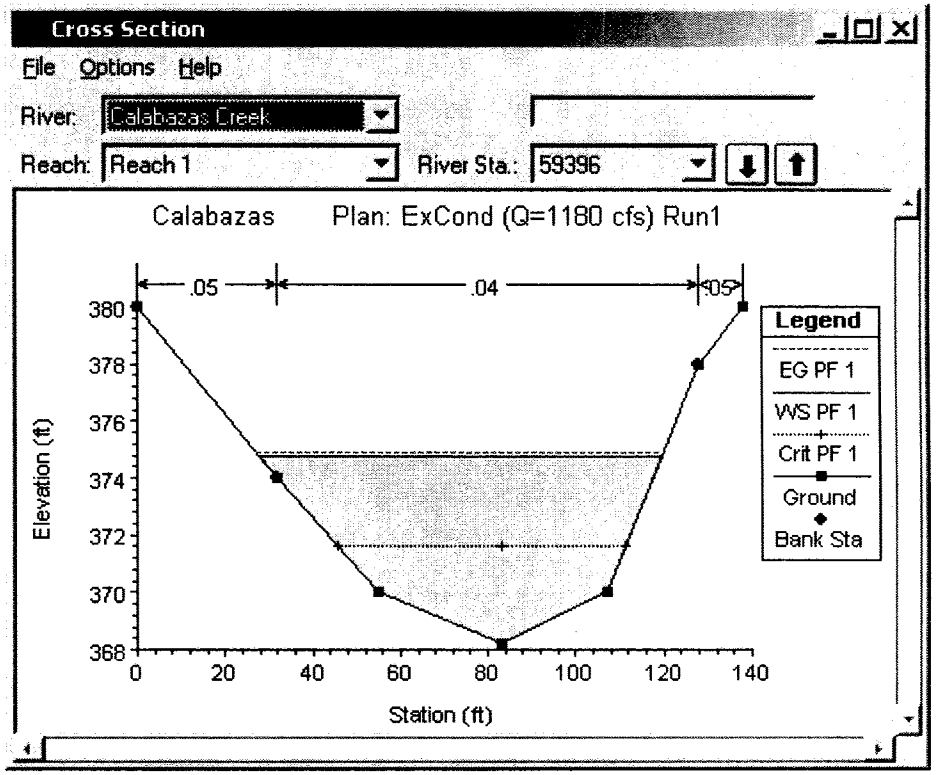
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 32 | 128 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Distance to next downstream cross section in main channel (ft)

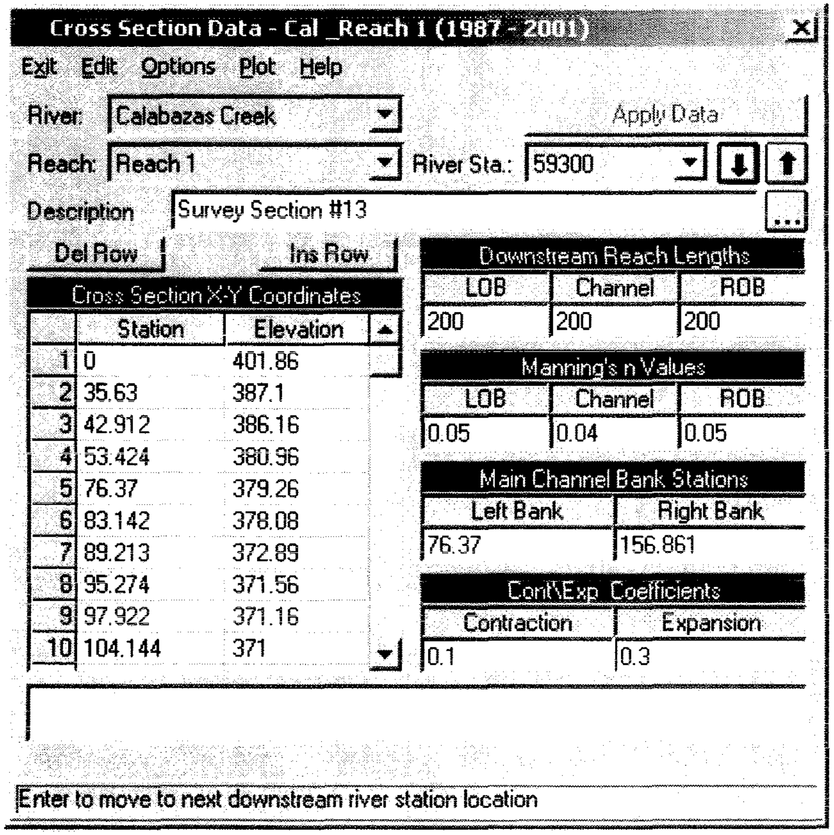


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59396



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59300

Description: Survey Section #13

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 401.86 |
| 2 | 35.63 | 387.1 |
| 3 | 42.912 | 386.16 |
| 4 | 53.424 | 380.96 |
| 5 | 76.37 | 379.26 |
| 6 | 83.142 | 378.08 |
| 7 | 89.213 | 372.89 |
| 8 | 95.274 | 371.56 |
| 9 | 97.922 | 371.16 |
| 10 | 104.144 | 371 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 200 | 200 | 200 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

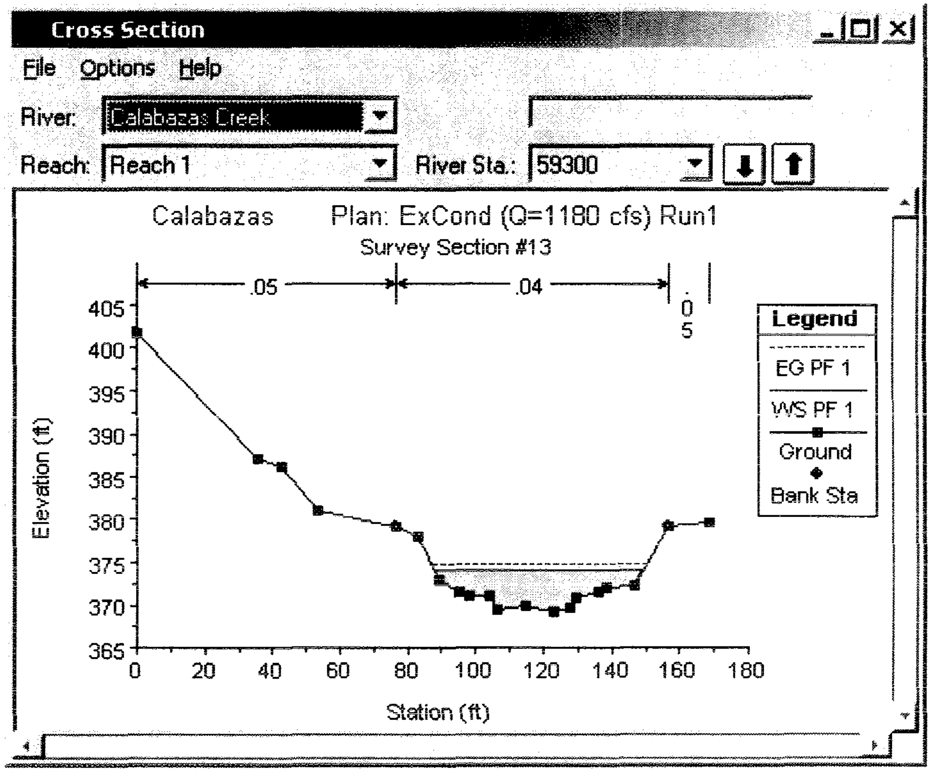
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 76.37 | 156.861 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

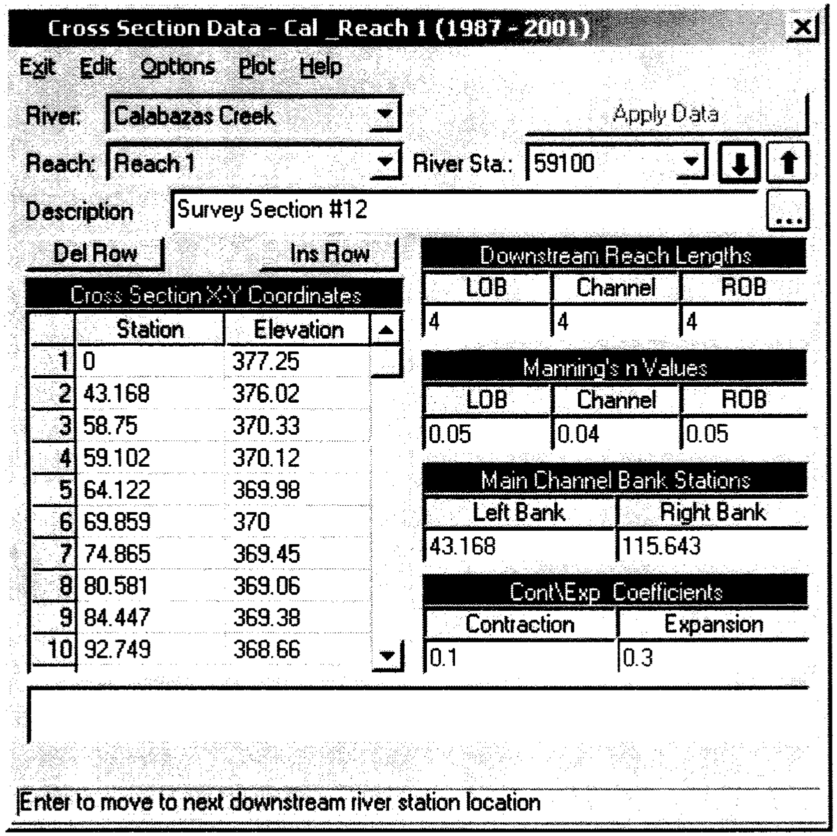
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59300


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1 River Sta.: 59100

Description: Survey Section #12

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 377.25 |
| 2 | 43.168 | 376.02 |
| 3 | 58.75 | 370.33 |
| 4 | 59.102 | 370.12 |
| 5 | 64.122 | 369.98 |
| 6 | 69.859 | 370 |
| 7 | 74.865 | 369.45 |
| 8 | 80.581 | 369.06 |
| 9 | 84.447 | 369.38 |
| 10 | 92.749 | 368.66 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 4 | 4 | 4 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

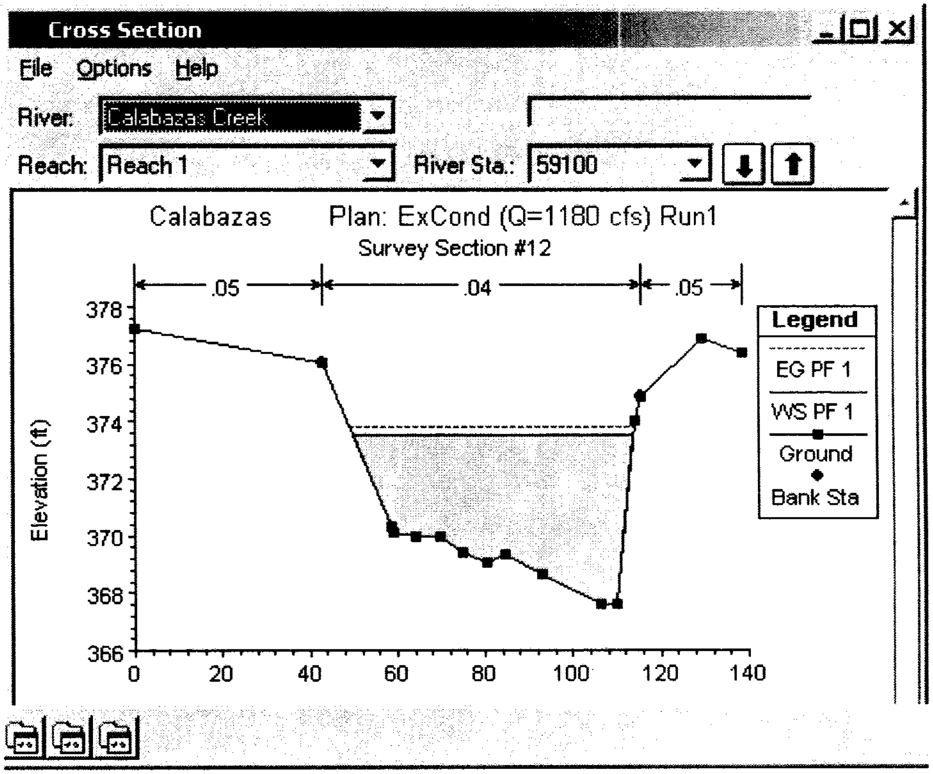
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 43.168 | 115.643 |

Cont\Exp Coefficients

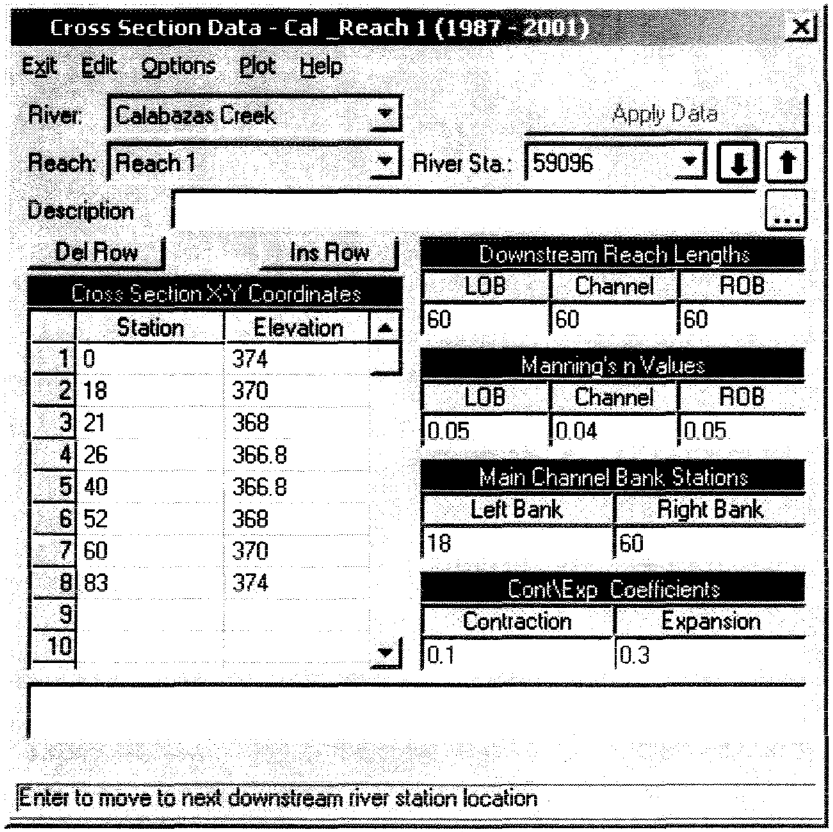
| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1 River Sta.: 59100



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59096

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 374 |
| 2 | 18 | 370 |
| 3 | 21 | 368 |
| 4 | 26 | 366.8 |
| 5 | 40 | 366.8 |
| 6 | 52 | 368 |
| 7 | 60 | 370 |
| 8 | 83 | 374 |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 60 | 60 | 60 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

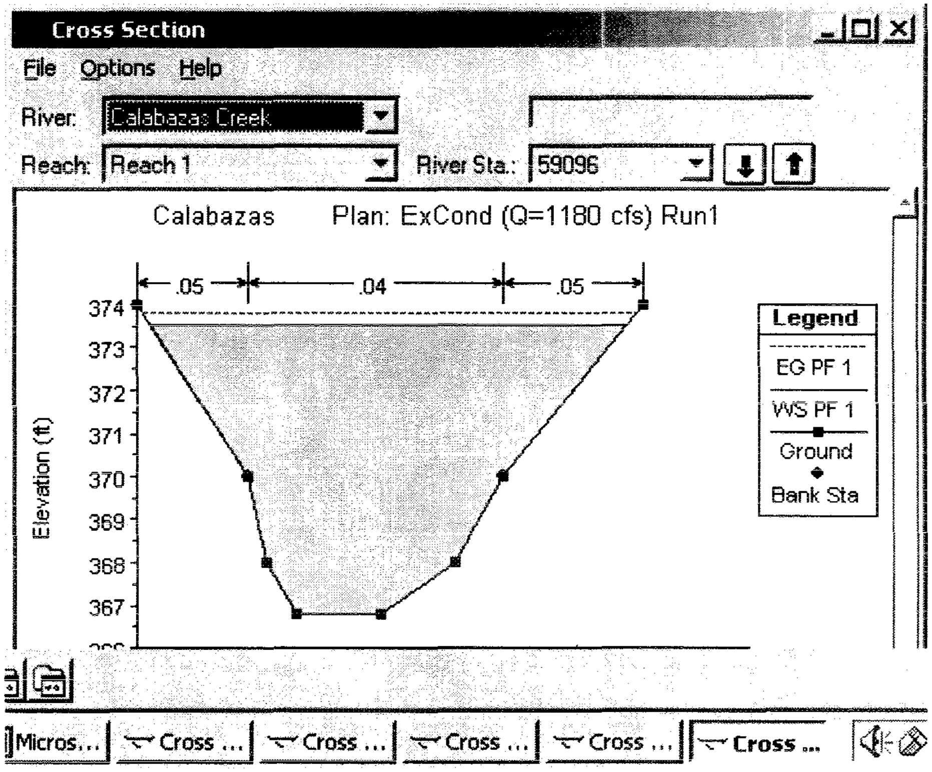
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 18 | 60 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

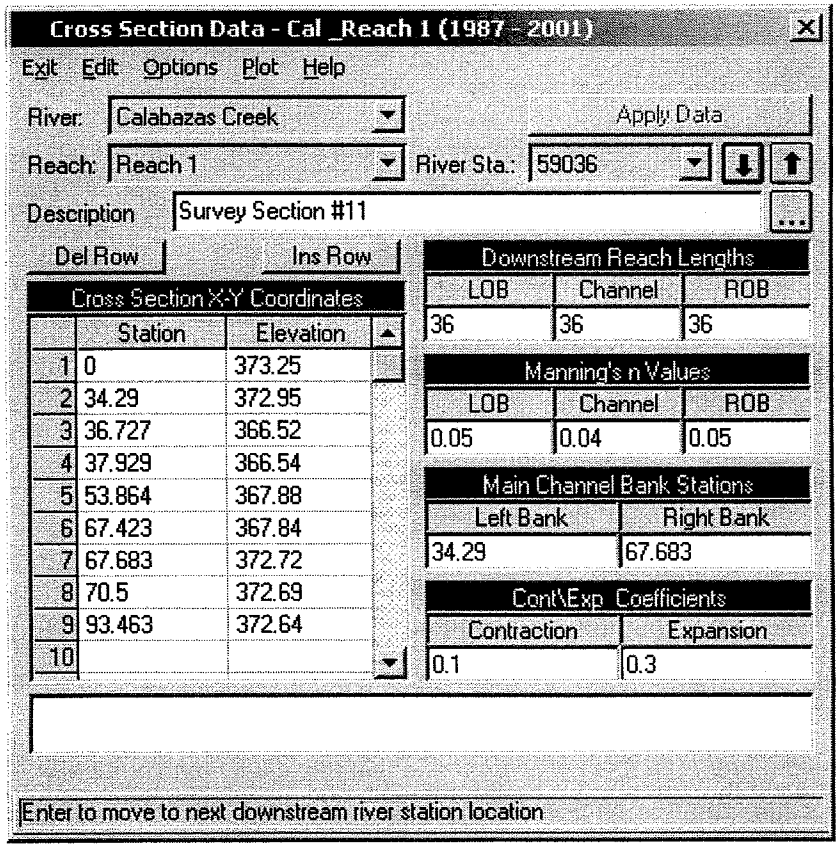


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59096



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59036

Description: Survey Section #11

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 373.25 |
| 2 | 34.29 | 372.95 |
| 3 | 36.727 | 366.52 |
| 4 | 37.929 | 366.54 |
| 5 | 53.864 | 367.88 |
| 6 | 67.423 | 367.84 |
| 7 | 67.683 | 372.72 |
| 8 | 70.5 | 372.69 |
| 9 | 93.463 | 372.64 |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 36 | 36 | 36 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

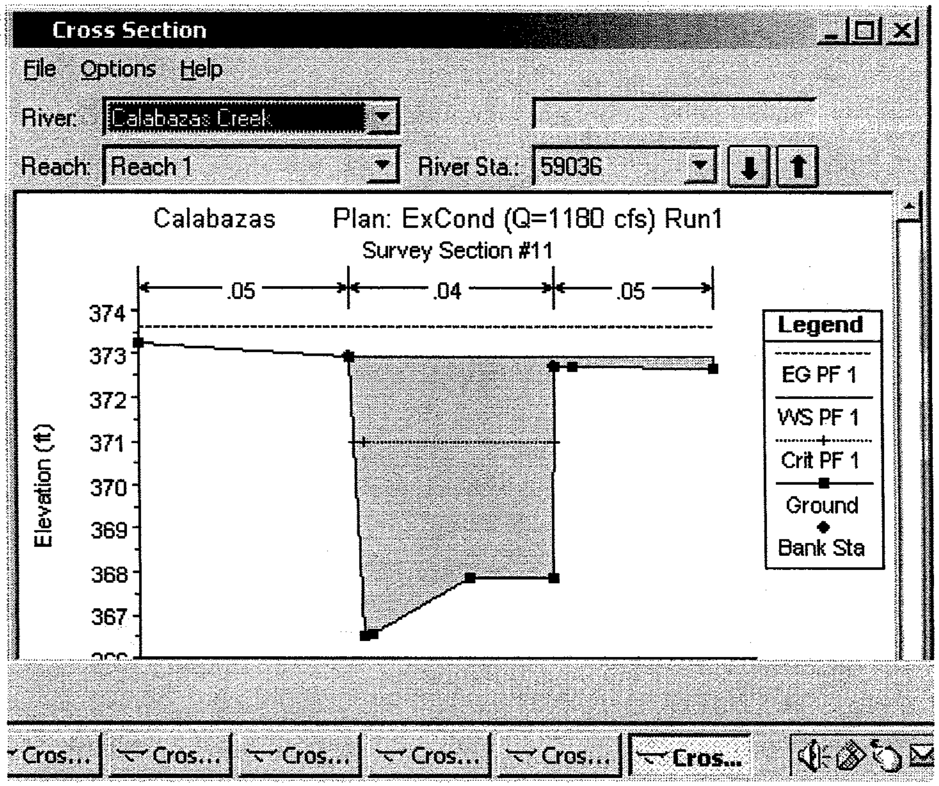
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 34.29 | 67.683 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

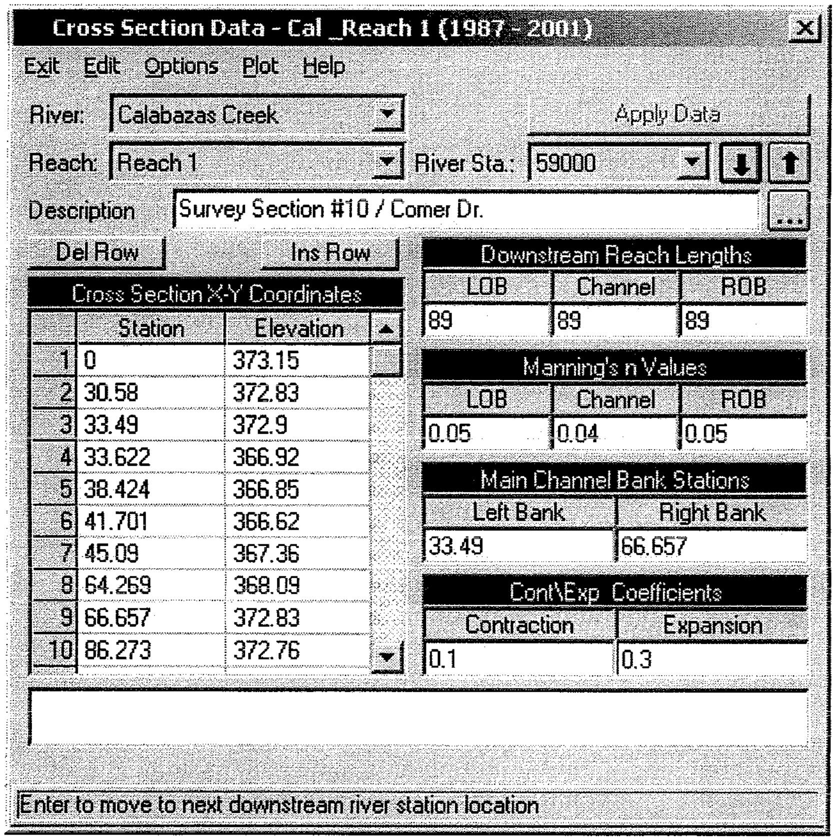


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 59036



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59000

Description: Survey Section #10 / Comer Dr.

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 373.15 |
| 2 | 30.58 | 372.83 |
| 3 | 33.49 | 372.9 |
| 4 | 33.622 | 366.92 |
| 5 | 38.424 | 366.85 |
| 6 | 41.701 | 366.62 |
| 7 | 45.09 | 367.36 |
| 8 | 64.269 | 368.09 |
| 9 | 66.657 | 372.83 |
| 10 | 86.273 | 372.76 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 89 | 89 | 89 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

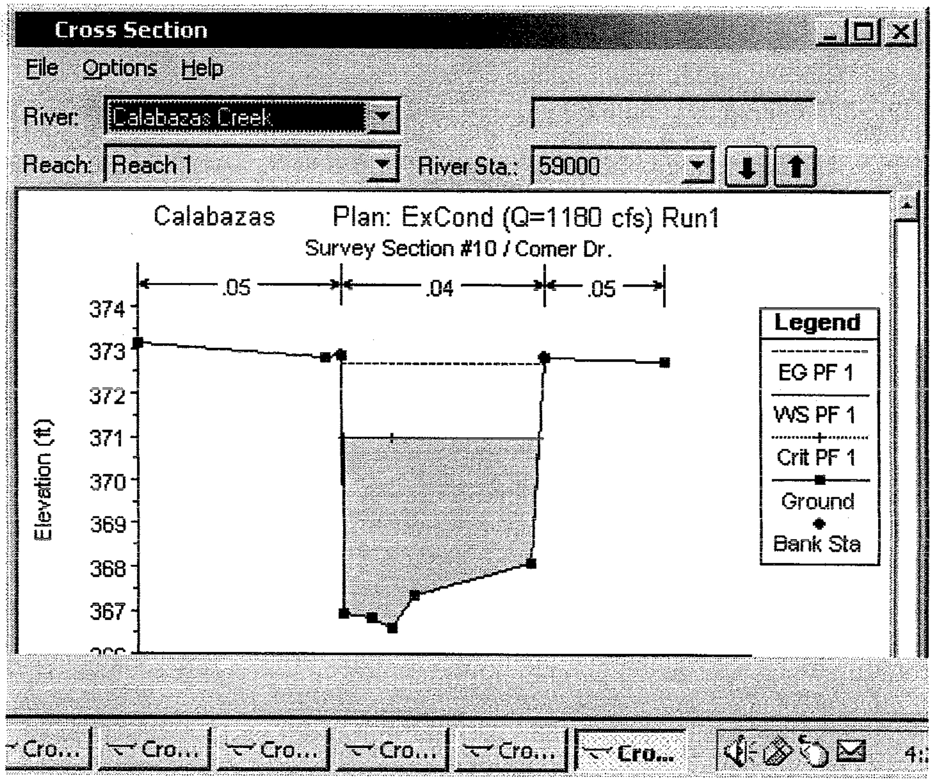
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 33.49 | 66.657 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

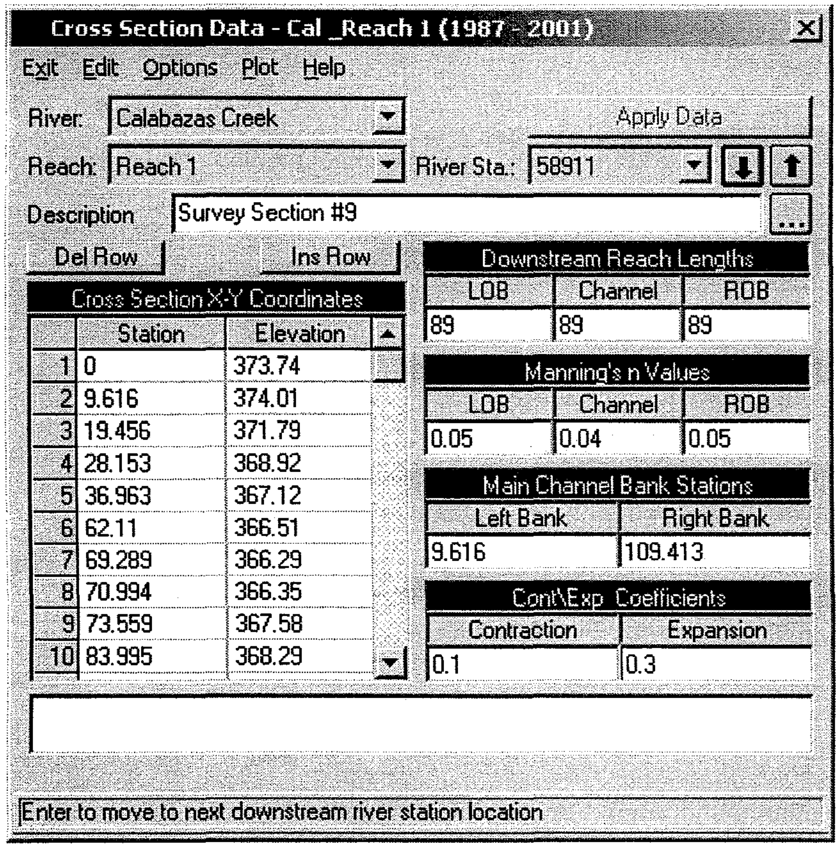
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 59000


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58911

Description: Survey Section #9

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 373.74 |
| 2 | 9.616 | 374.01 |
| 3 | 19.456 | 371.79 |
| 4 | 28.153 | 368.92 |
| 5 | 36.963 | 367.12 |
| 6 | 62.11 | 366.51 |
| 7 | 69.289 | 366.29 |
| 8 | 70.994 | 366.35 |
| 9 | 73.559 | 367.58 |
| 10 | 83.995 | 368.29 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 89 | 89 | 89 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

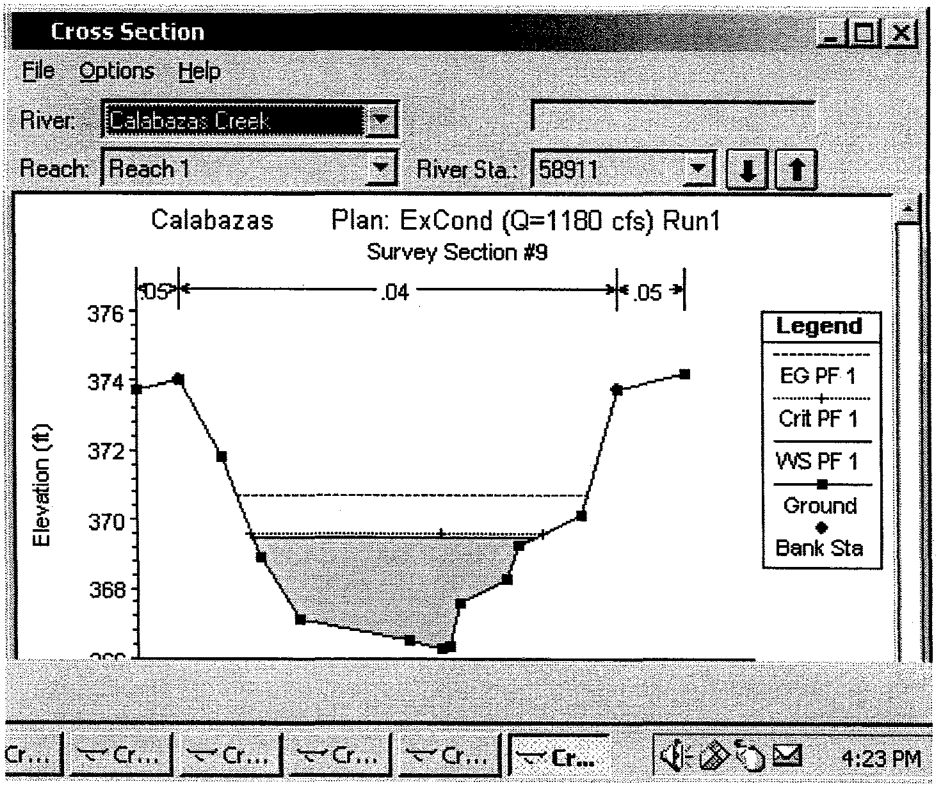
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 9.616 | 109.413 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

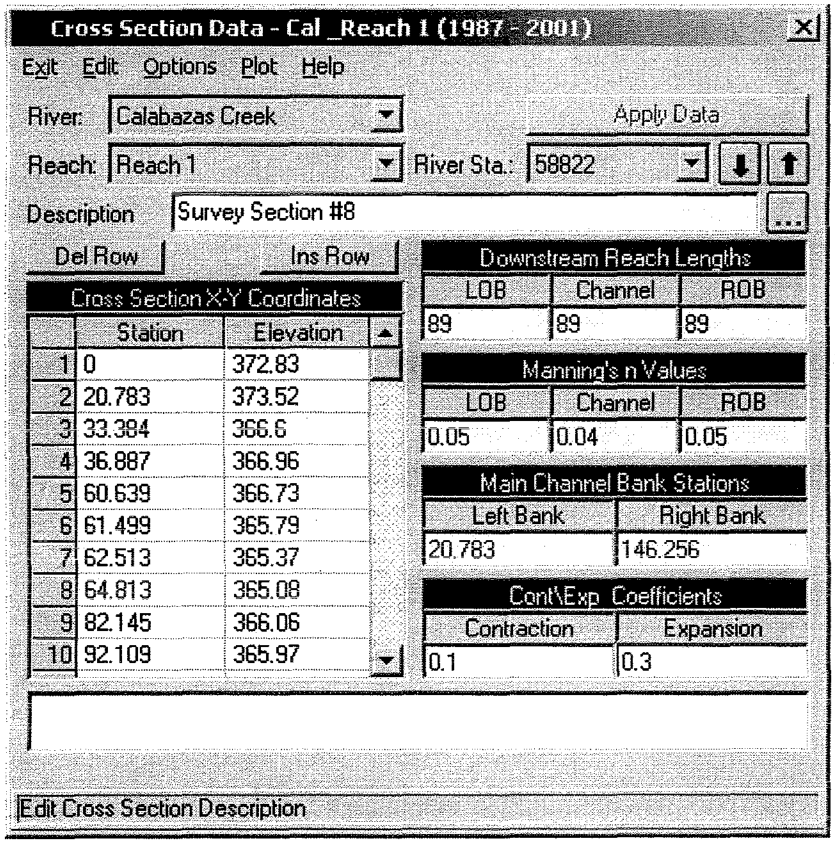
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58911



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58822

Description: Survey Section #8

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 372.83 |
| 2 | 20.783 | 373.52 |
| 3 | 33.384 | 366.6 |
| 4 | 36.887 | 366.96 |
| 5 | 60.639 | 366.73 |
| 6 | 61.499 | 365.79 |
| 7 | 62.513 | 365.37 |
| 8 | 64.813 | 365.08 |
| 9 | 82.145 | 366.06 |
| 10 | 92.109 | 365.97 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 89 | 89 | 89 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

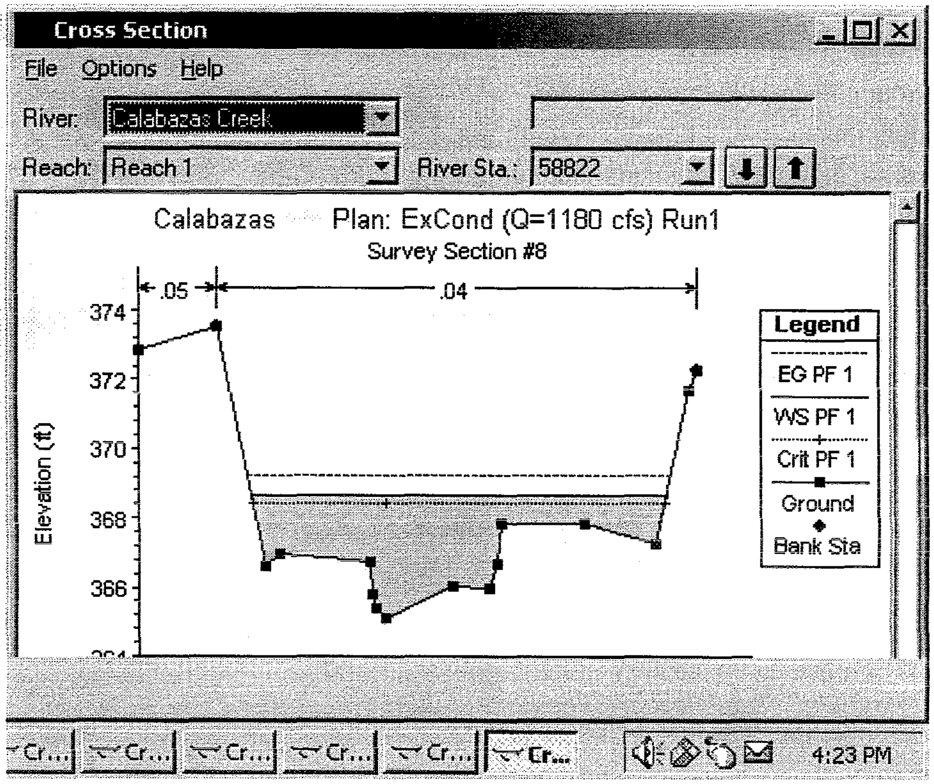
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 20.783 | 146.256 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

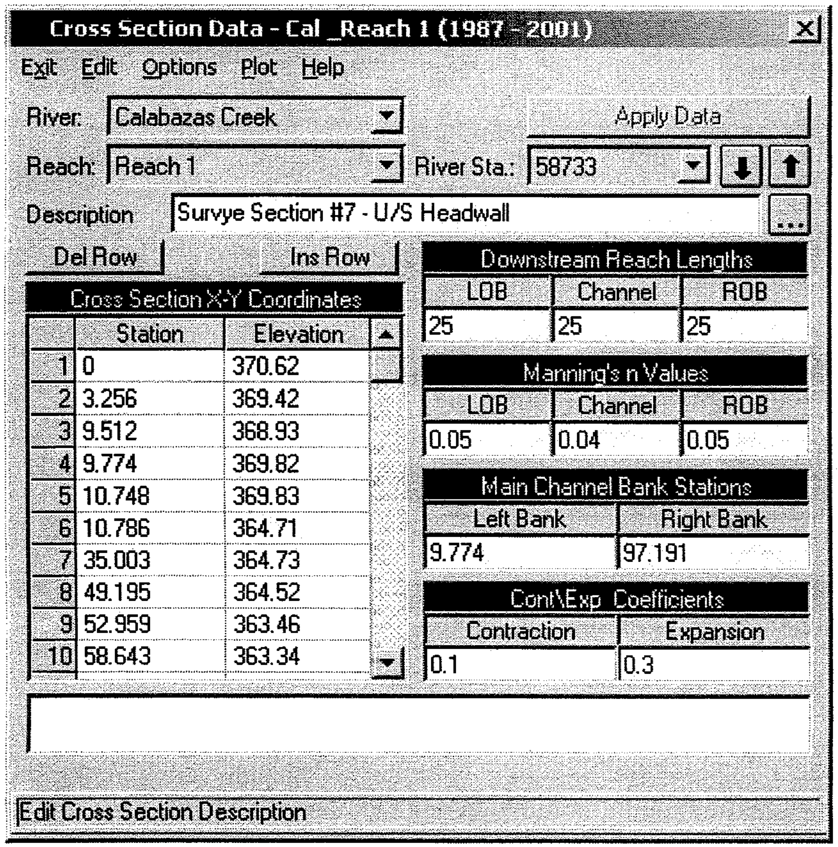
Edit Cross Section Description



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58822



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58733

Description: Survye Section #7 - U/S Headwall

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 370.62 |
| 2 | 3.256 | 369.42 |
| 3 | 9.512 | 368.93 |
| 4 | 9.774 | 369.82 |
| 5 | 10.748 | 369.83 |
| 6 | 10.786 | 364.71 |
| 7 | 35.003 | 364.73 |
| 8 | 49.195 | 364.52 |
| 9 | 52.959 | 363.46 |
| 10 | 58.643 | 363.34 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 25 | 25 | 25 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

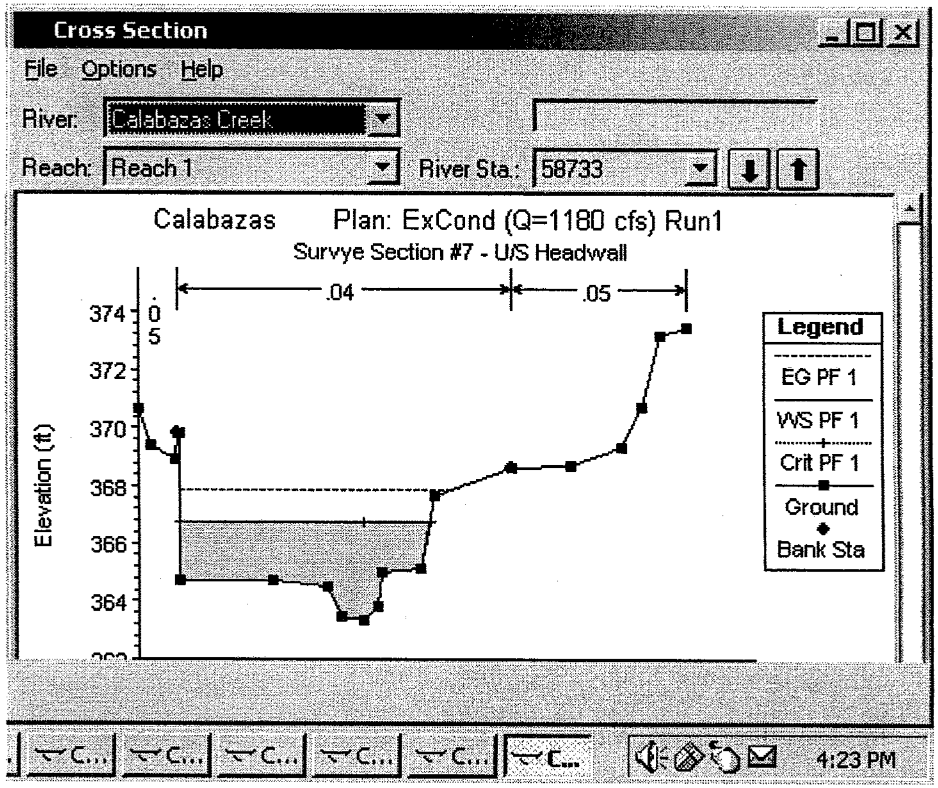
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 9.774 | 97.191 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Edit Cross Section Description



Cross Section

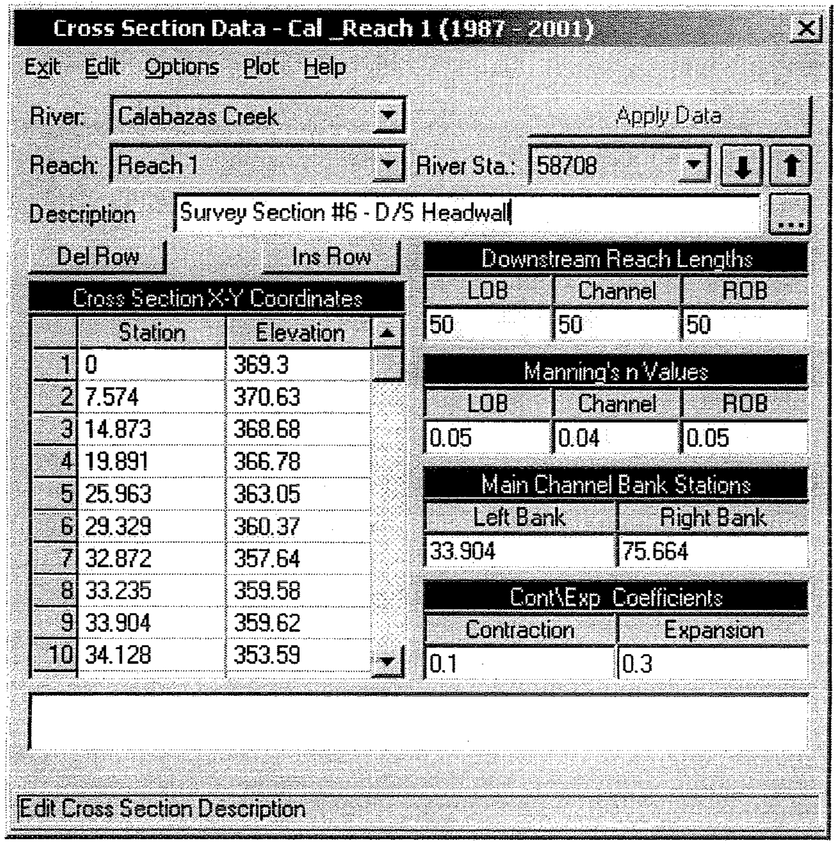
River: Calabazas Creek

Reach: Reach 1

River Sta.: 58733

Calabazas Plan: ExCond (Q=1180 cfs) Run1

Survye Section #7 - U/S Headwall


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row
Edit Cross Section Description

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58708

Description: Survey Section #6 - D/S Headwall

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 369.3 |
| 2 | 7.574 | 370.63 |
| 3 | 14.873 | 368.68 |
| 4 | 19.891 | 366.78 |
| 5 | 25.963 | 363.05 |
| 6 | 29.329 | 360.37 |
| 7 | 32.872 | 357.64 |
| 8 | 33.235 | 359.58 |
| 9 | 33.904 | 359.62 |
| 10 | 34.128 | 353.59 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 50 | 50 | 50 |

Manning's n Values

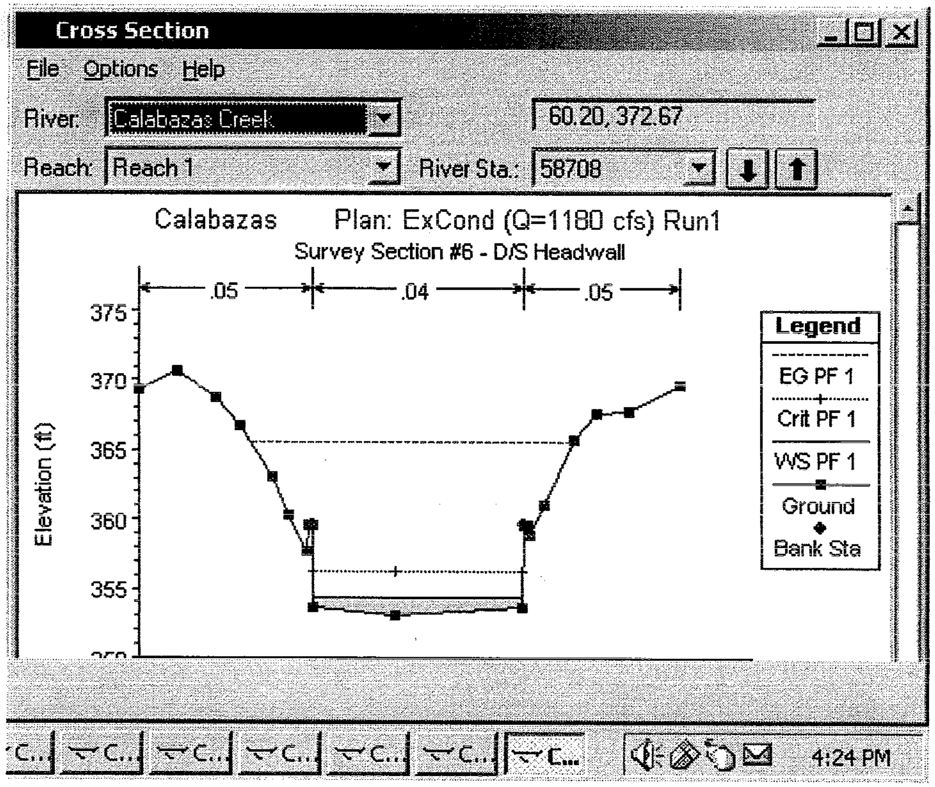
| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 33.904 | 75.664 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

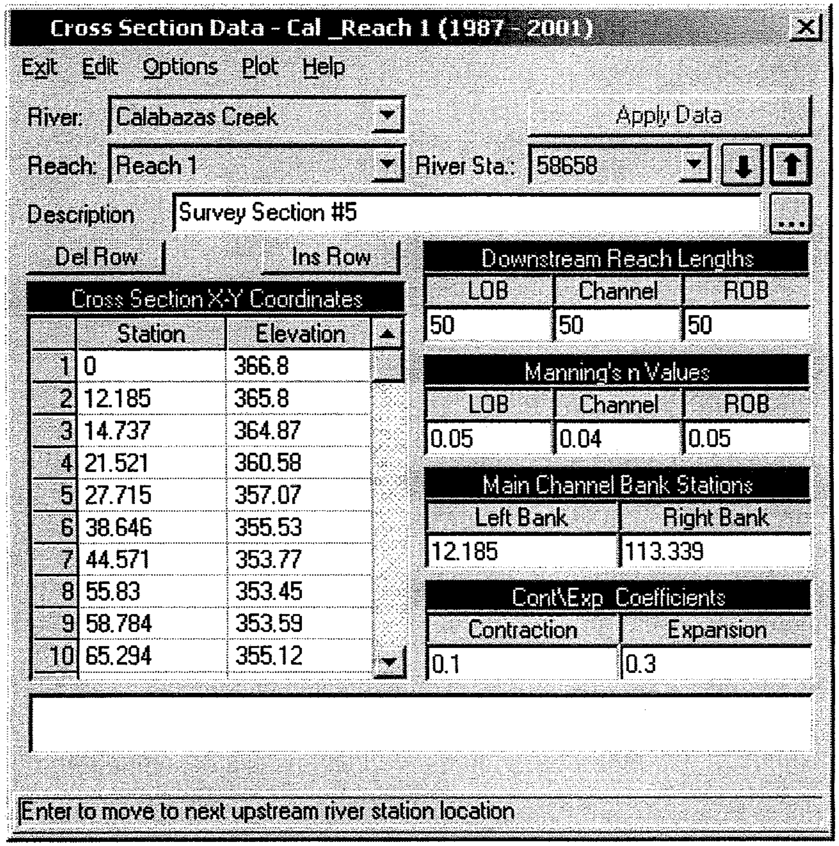


River: Calabazas Creek

60.20, 372.67

Reach: Reach 1

River Sta.: 58708



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58658

Description: Survey Section #5

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 366.8 |
| 2 | 12.185 | 365.8 |
| 3 | 14.737 | 364.87 |
| 4 | 21.521 | 360.58 |
| 5 | 27.715 | 357.07 |
| 6 | 38.646 | 355.53 |
| 7 | 44.571 | 353.77 |
| 8 | 55.83 | 353.45 |
| 9 | 58.784 | 353.59 |
| 10 | 65.294 | 355.12 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 50 | 50 | 50 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

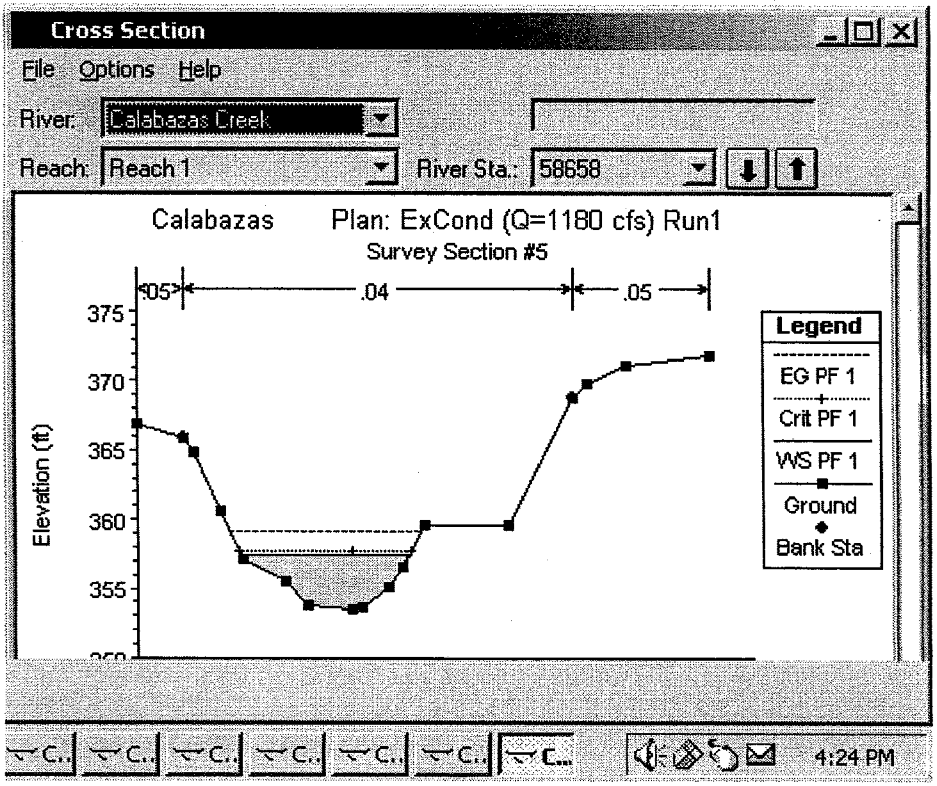
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 12.185 | 113.339 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next upstream river station location

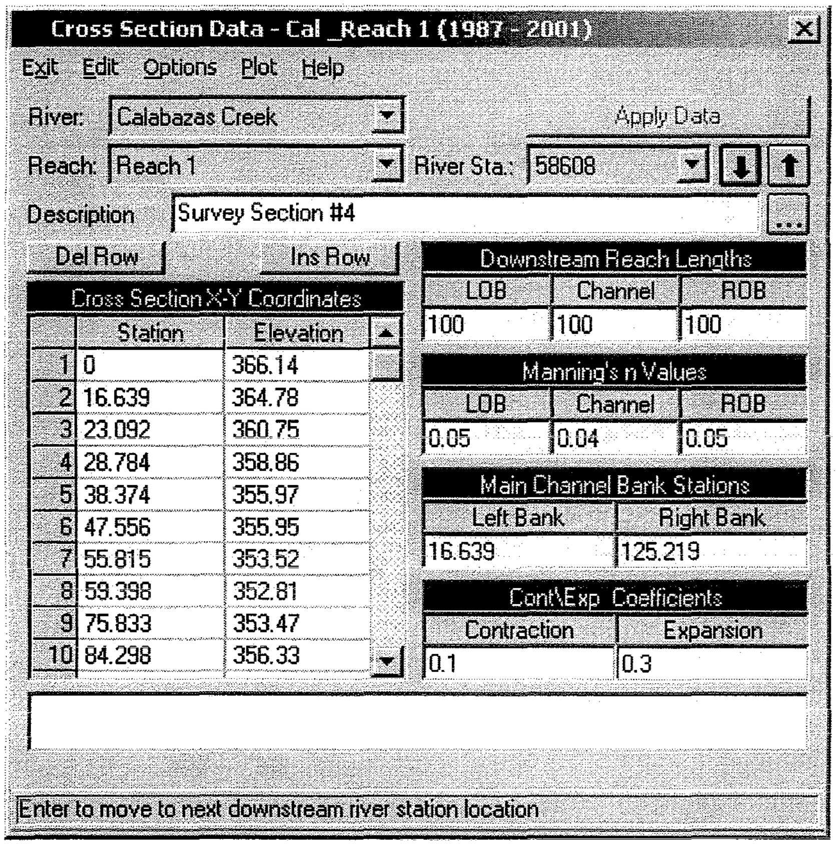


**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58658



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 58608

Description: Survey Section #4

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 366.14 |
| 2 | 16.639 | 364.78 |
| 3 | 23.092 | 360.75 |
| 4 | 28.784 | 358.86 |
| 5 | 38.374 | 355.97 |
| 6 | 47.556 | 355.95 |
| 7 | 55.815 | 353.52 |
| 8 | 59.398 | 352.81 |
| 9 | 75.833 | 353.47 |
| 10 | 84.298 | 356.33 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

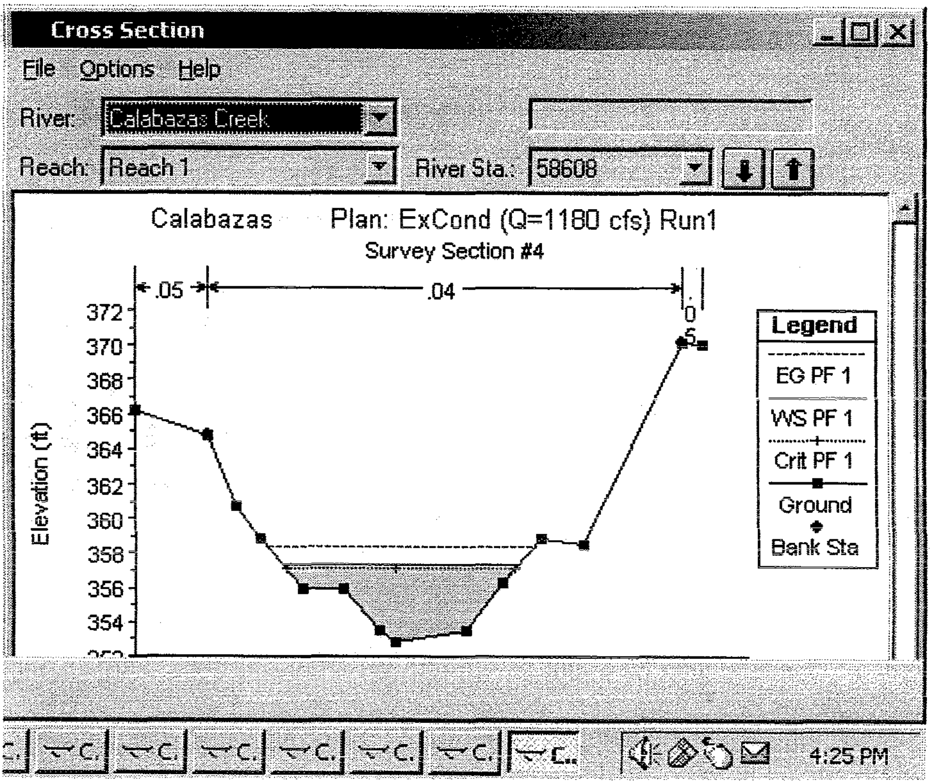
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 16.639 | 125.219 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location



**Cross Section**

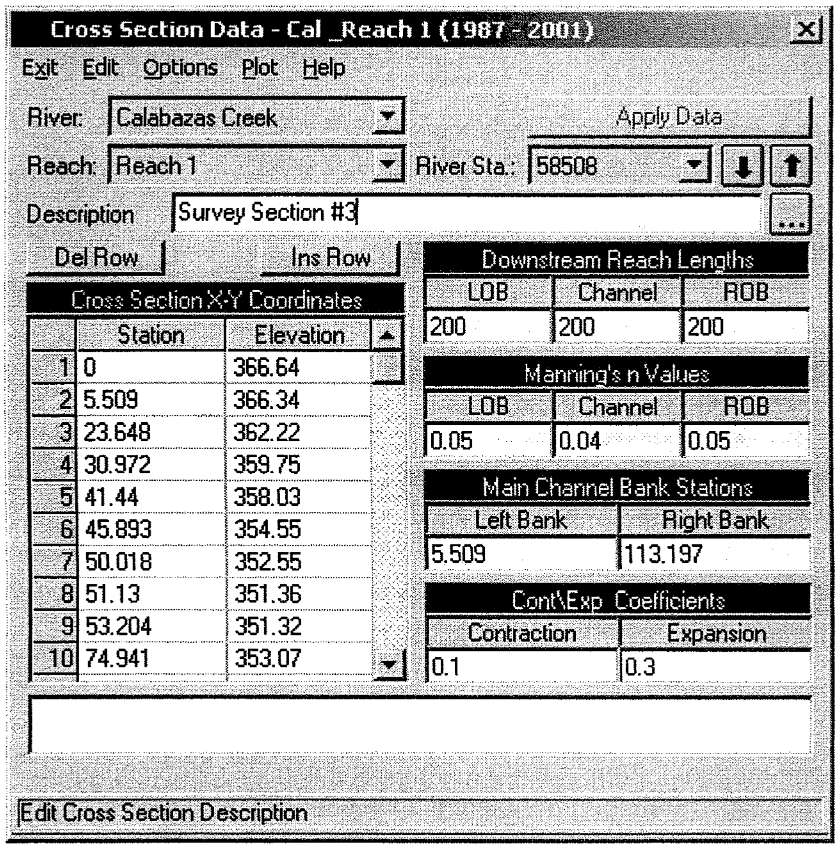
River: Calabazas Creek

Reach: Reach 1

River Sta.: 58608

Calabazas Plan: ExCond (Q=1180 cfs) Run1

Survey Section #4



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58508

Description: Survey Section #3

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 366.64 |
| 2 | 5.509 | 366.34 |
| 3 | 23.648 | 362.22 |
| 4 | 30.972 | 359.75 |
| 5 | 41.44 | 358.03 |
| 6 | 45.893 | 354.55 |
| 7 | 50.018 | 352.55 |
| 8 | 51.13 | 351.36 |
| 9 | 53.204 | 351.32 |
| 10 | 74.941 | 353.07 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 200 | 200 | 200 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

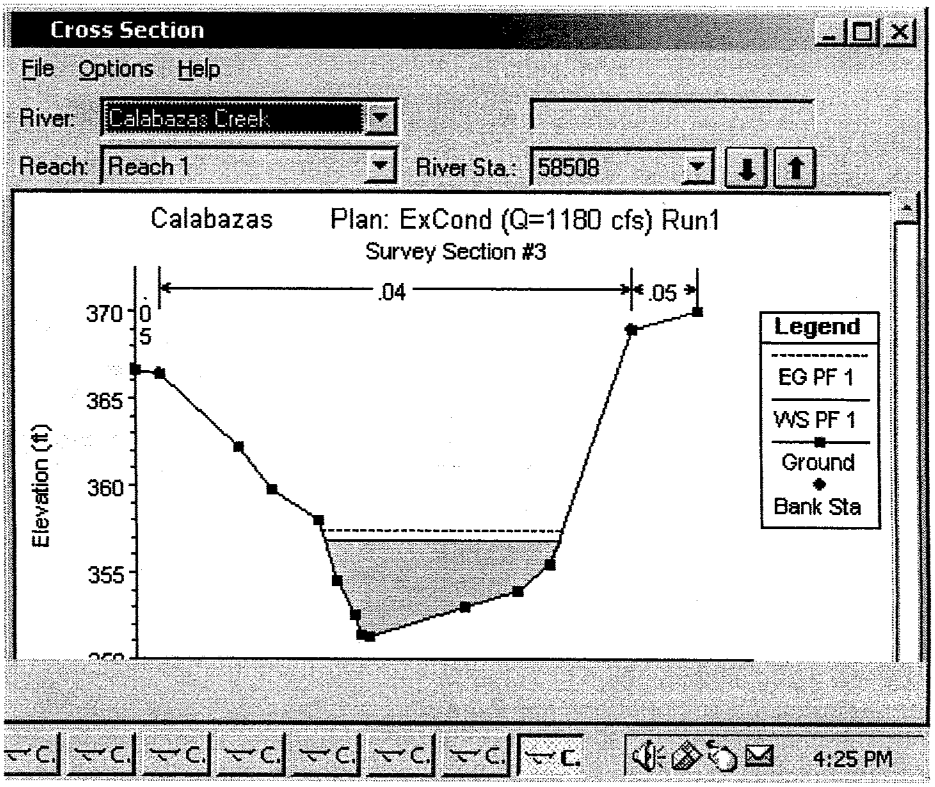
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 5.509 | 113.197 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

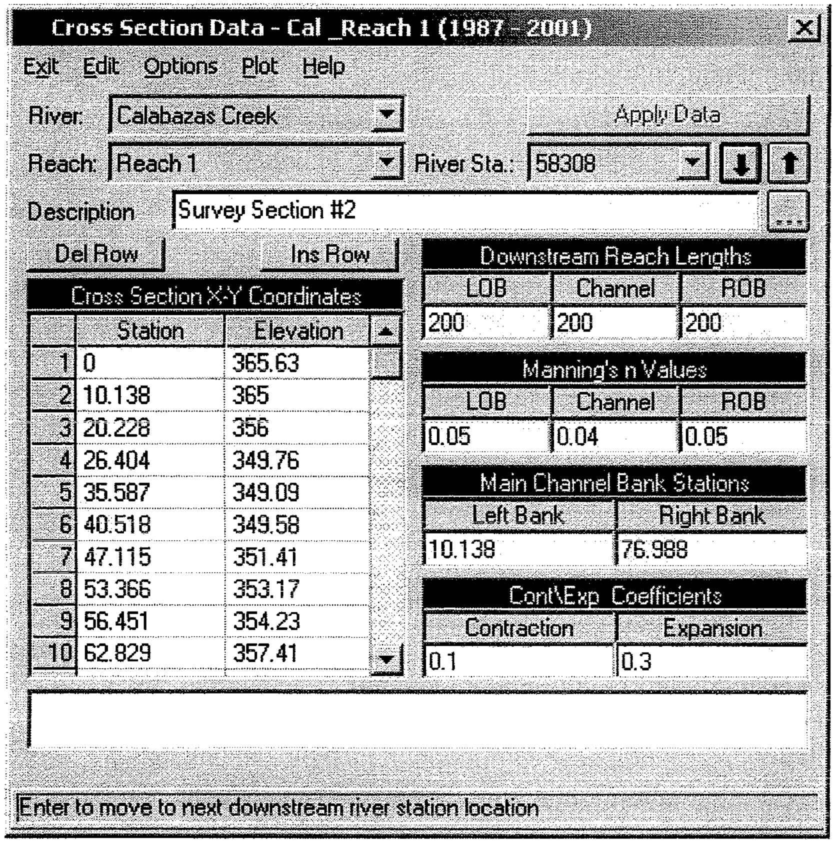
Edit Cross Section Description



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58508



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58308

Description: Survey Section #2

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 365.63 |
| 2 | 10.138 | 365 |
| 3 | 20.228 | 356 |
| 4 | 26.404 | 349.76 |
| 5 | 35.587 | 349.09 |
| 6 | 40.518 | 349.58 |
| 7 | 47.115 | 351.41 |
| 8 | 53.366 | 353.17 |
| 9 | 56.451 | 354.23 |
| 10 | 62.829 | 357.41 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 200 | 200 | 200 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

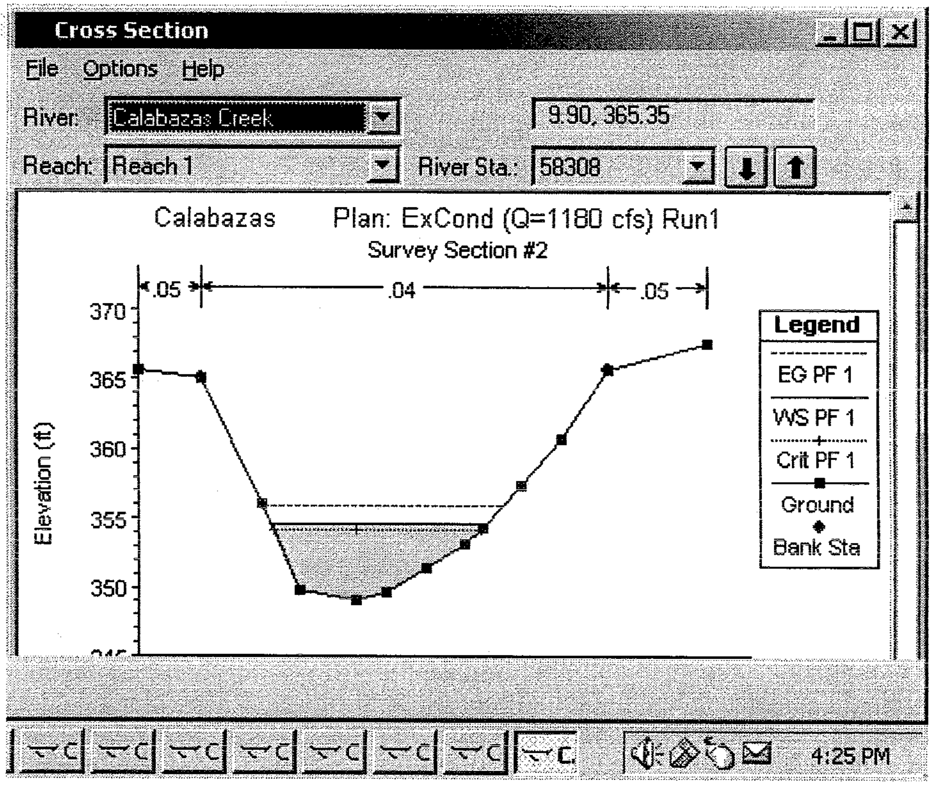
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 10.138 | 76.988 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

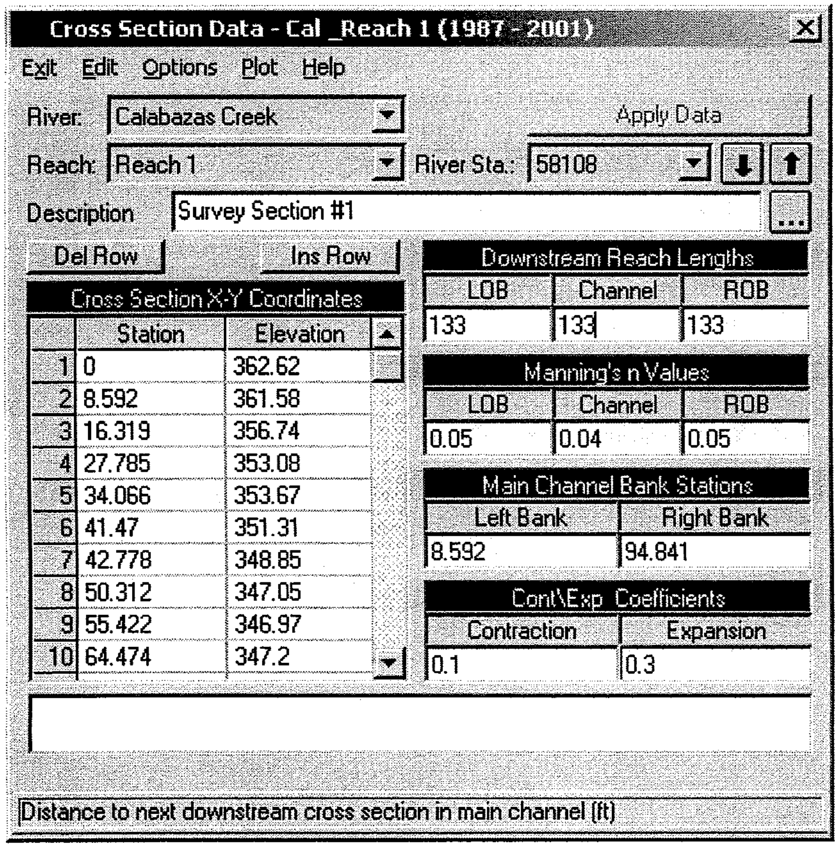


River: Calabazas Creek

9.90, 365.35

Reach: Reach 1

River Sta.: 58308



River: Calabazas Creek

Reach: Reach 1

River Sta.: 58108

Description: Survey Section #1

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 362.62 |
| 2 | 8.592 | 361.58 |
| 3 | 16.319 | 356.74 |
| 4 | 27.785 | 353.08 |
| 5 | 34.066 | 353.67 |
| 6 | 41.47 | 351.31 |
| 7 | 42.778 | 348.85 |
| 8 | 50.312 | 347.05 |
| 9 | 55.422 | 346.97 |
| 10 | 64.474 | 347.2 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 133 | 133 | 133 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

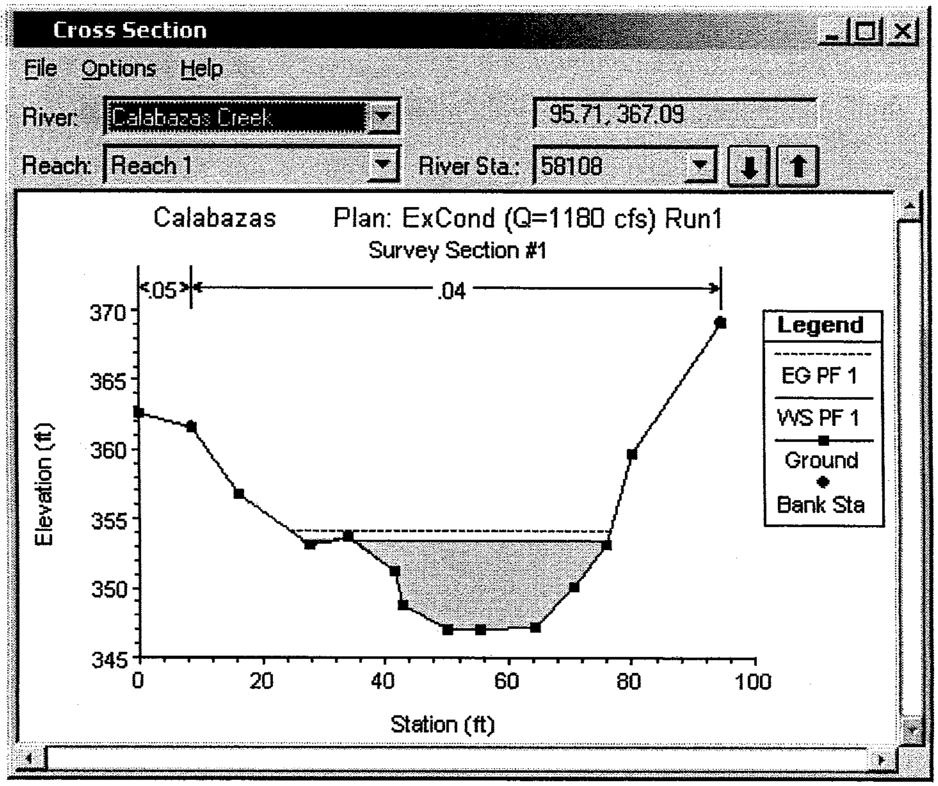
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 8.592 | 94.841 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Distance to next downstream cross section in main channel (ft)

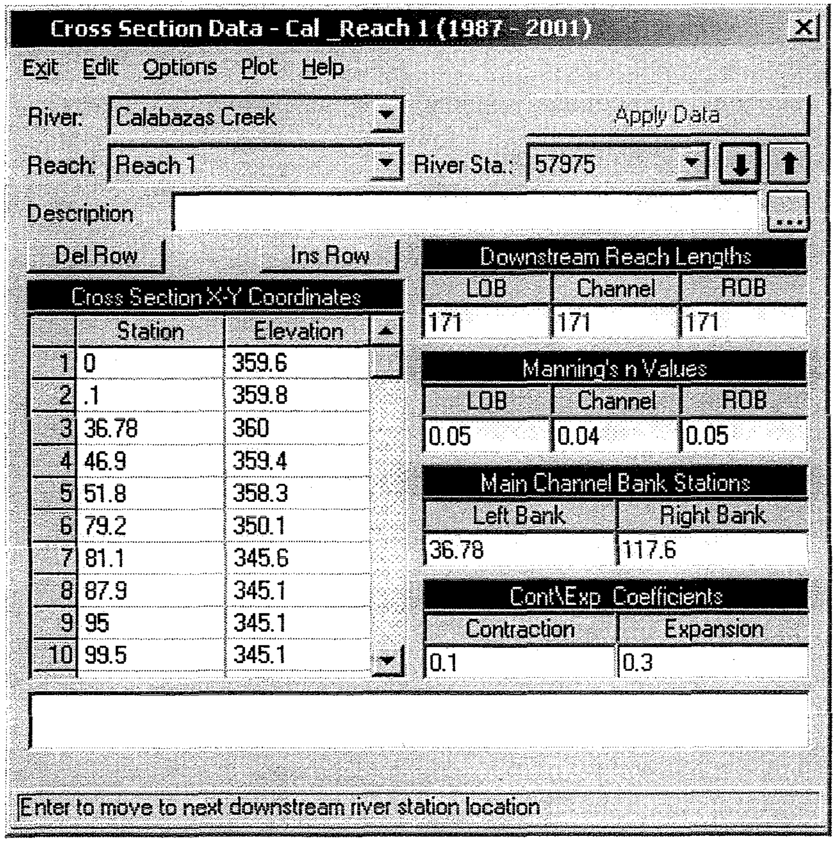


River: Calabazas Creek

95.71, 367.09

Reach: Reach 1

River Sta.: 58108



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57975

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 359.6 |
| 2 | .1 | 359.8 |
| 3 | 36.78 | 360 |
| 4 | 46.9 | 359.4 |
| 5 | 51.8 | 358.3 |
| 6 | 79.2 | 350.1 |
| 7 | 81.1 | 345.6 |
| 8 | 87.9 | 345.1 |
| 9 | 95 | 345.1 |
| 10 | 99.5 | 345.1 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 171 | 171 | 171 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.05 | 0.04 | 0.05 |

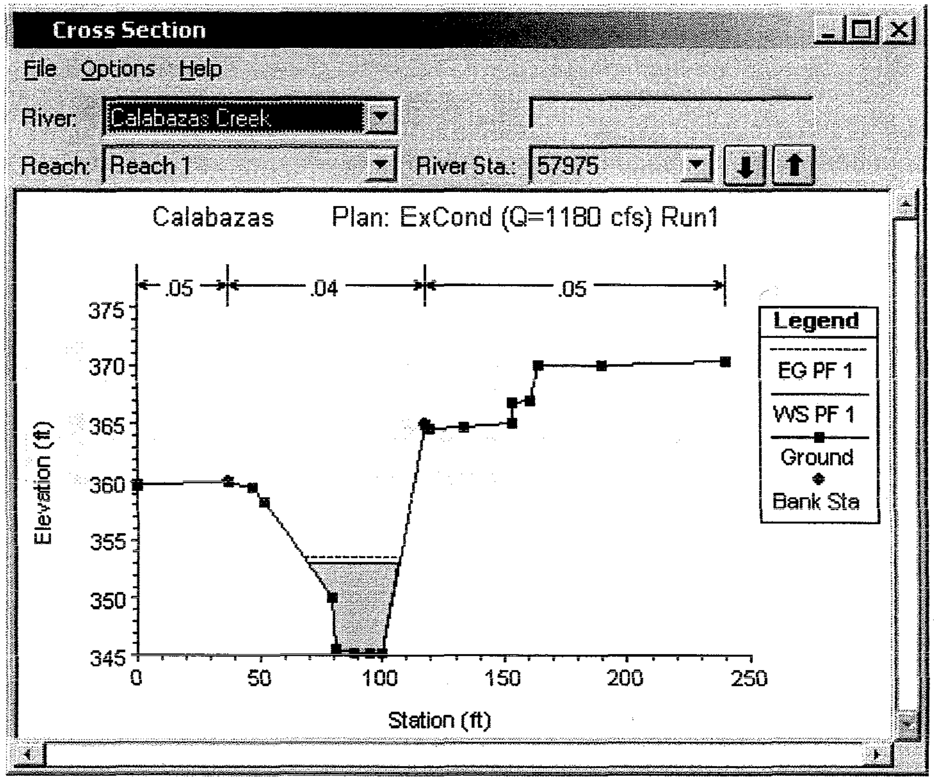
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 36.78 | 117.6 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.1 | 0.3 |

Enter to move to next downstream river station location

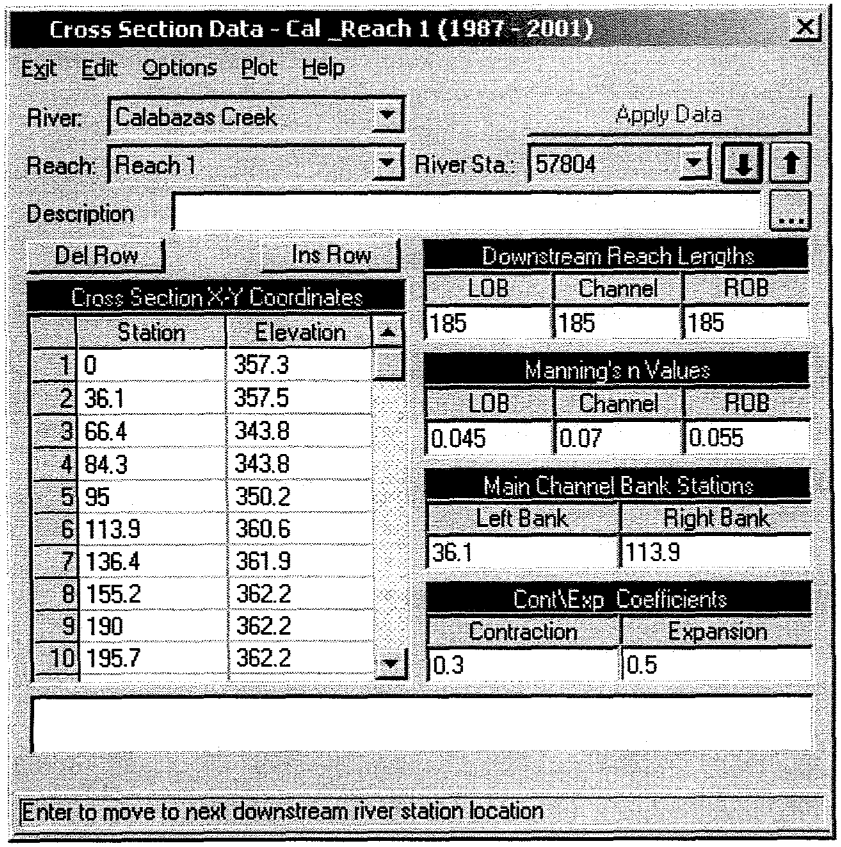


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57975



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57804

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 357.3 |
| 2 | 36.1 | 357.5 |
| 3 | 66.4 | 343.8 |
| 4 | 84.3 | 343.8 |
| 5 | 95 | 350.2 |
| 6 | 113.9 | 360.6 |
| 7 | 136.4 | 361.9 |
| 8 | 155.2 | 362.2 |
| 9 | 190 | 362.2 |
| 10 | 195.7 | 362.2 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 185 | 185 | 185 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

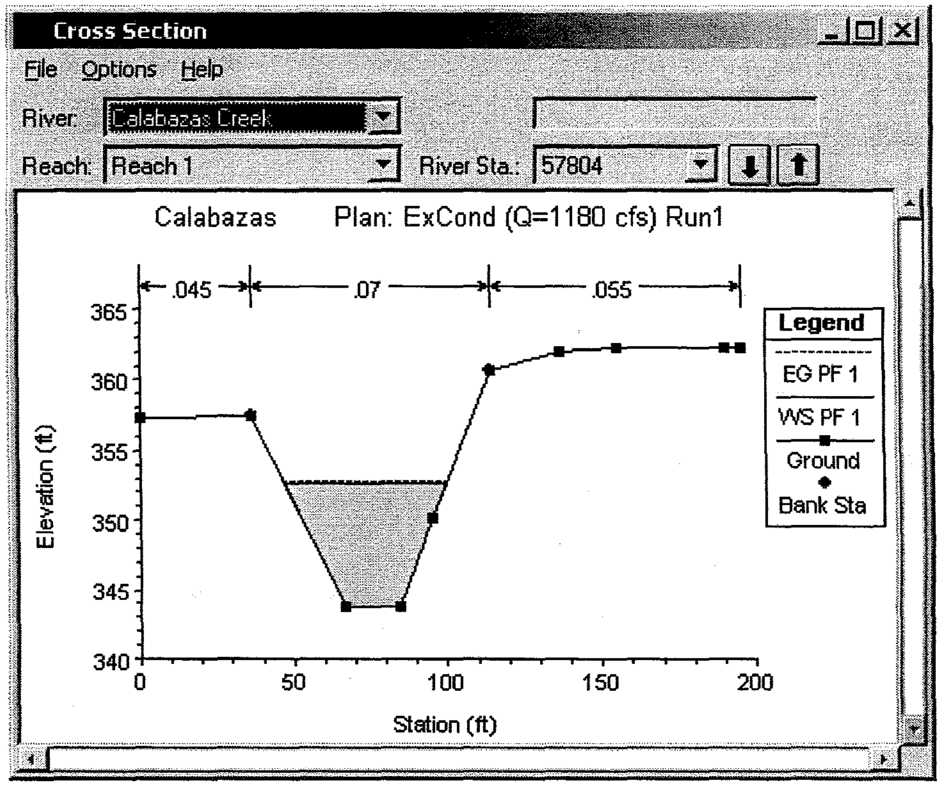
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 36.1 | 113.9 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

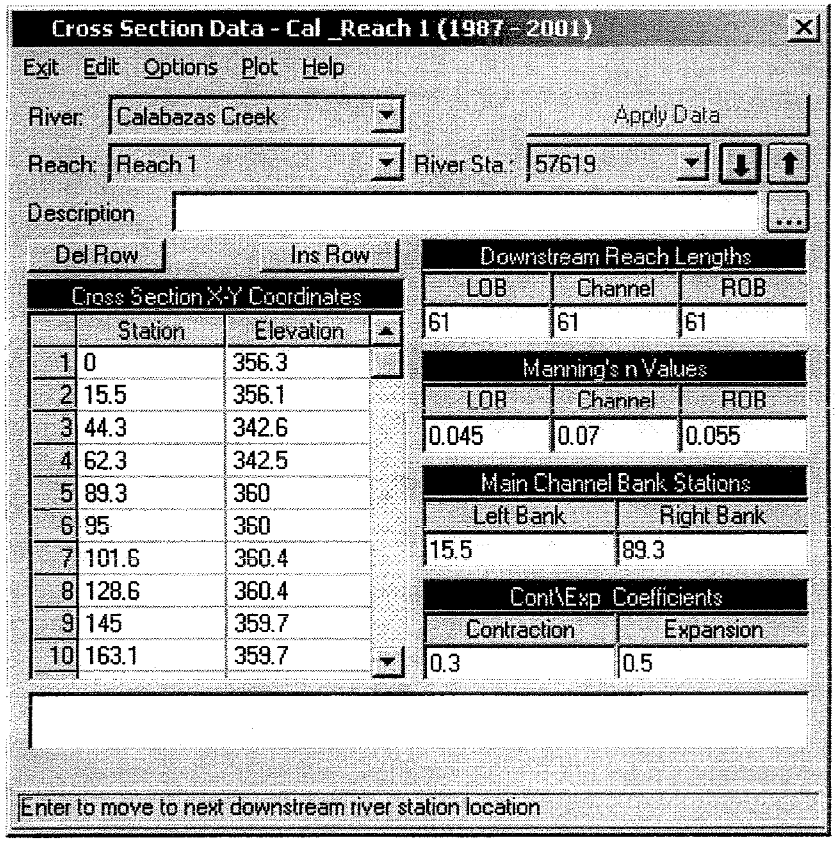


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57804



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57619

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 356.3 |
| 2 | 15.5 | 356.1 |
| 3 | 44.3 | 342.6 |
| 4 | 62.3 | 342.5 |
| 5 | 89.3 | 360 |
| 6 | 95 | 360 |
| 7 | 101.6 | 360.4 |
| 8 | 128.6 | 360.4 |
| 9 | 145 | 359.7 |
| 10 | 163.1 | 359.7 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 61 | 61 | 61 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

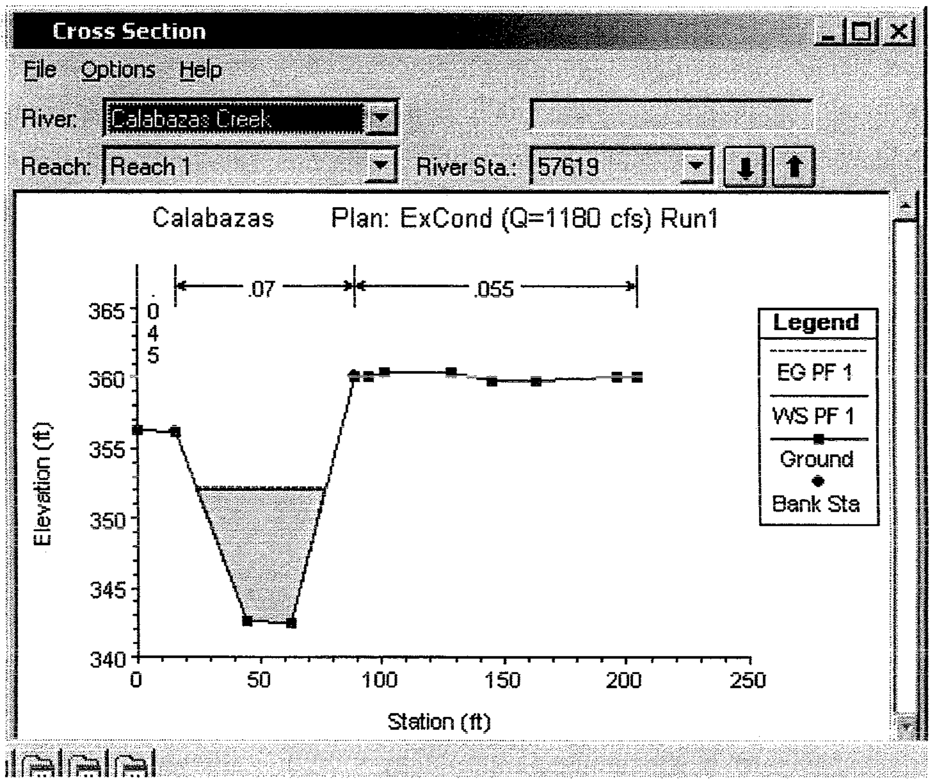
Main Channel Bank Stations

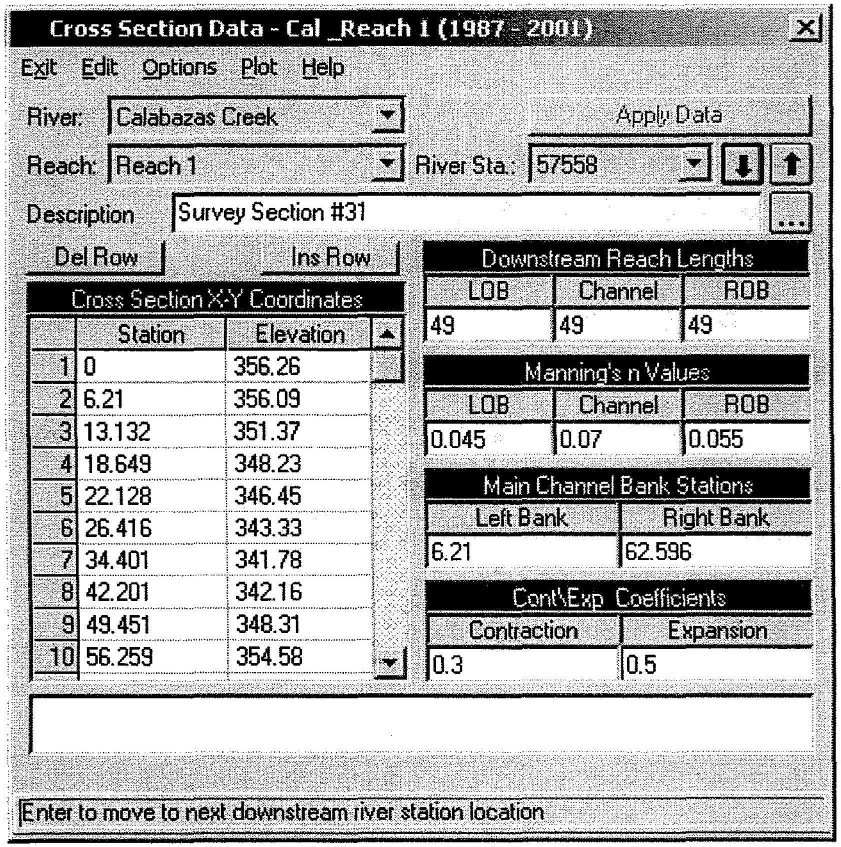
| Left Bank | Right Bank |
|---|---|
| 15.5 | 89.3 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location





River: Calabazas Creek

Reach: Reach 1

River Sta.: 57558

Description: Survey Section #31

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 356.26 |
| 2 | 6.21 | 356.09 |
| 3 | 13.132 | 351.37 |
| 4 | 18.649 | 348.23 |
| 5 | 22.128 | 346.45 |
| 6 | 26.416 | 343.33 |
| 7 | 34.401 | 341.78 |
| 8 | 42.201 | 342.16 |
| 9 | 49.451 | 348.31 |
| 10 | 56.259 | 354.58 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 49 | 49 | 49 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

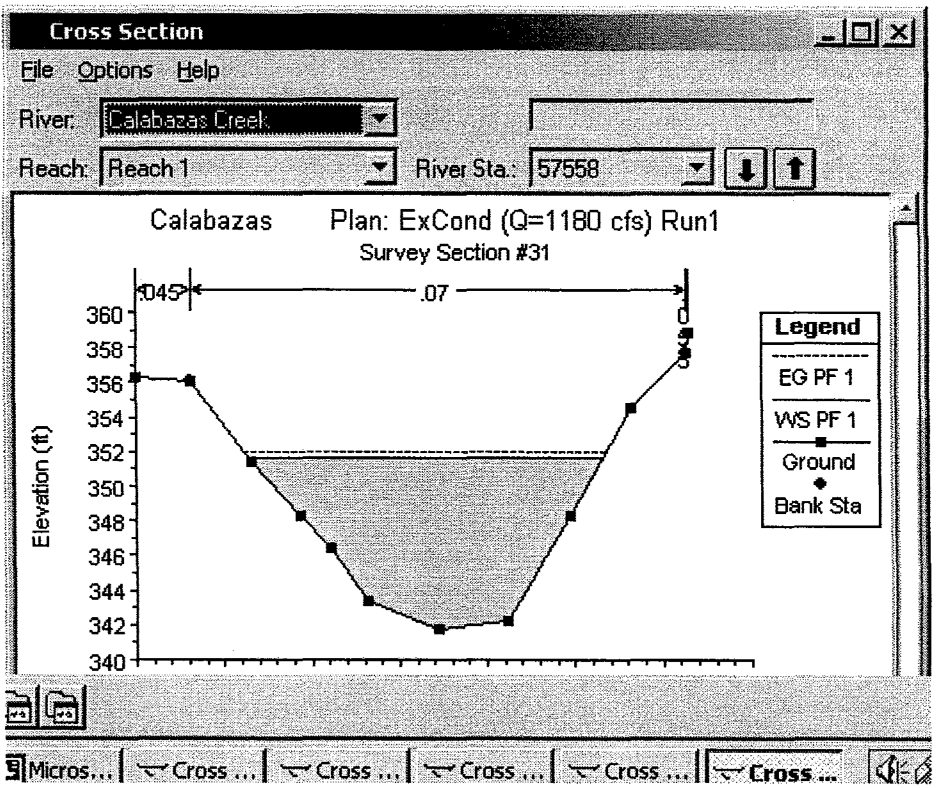
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 6.21 | 62.596 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

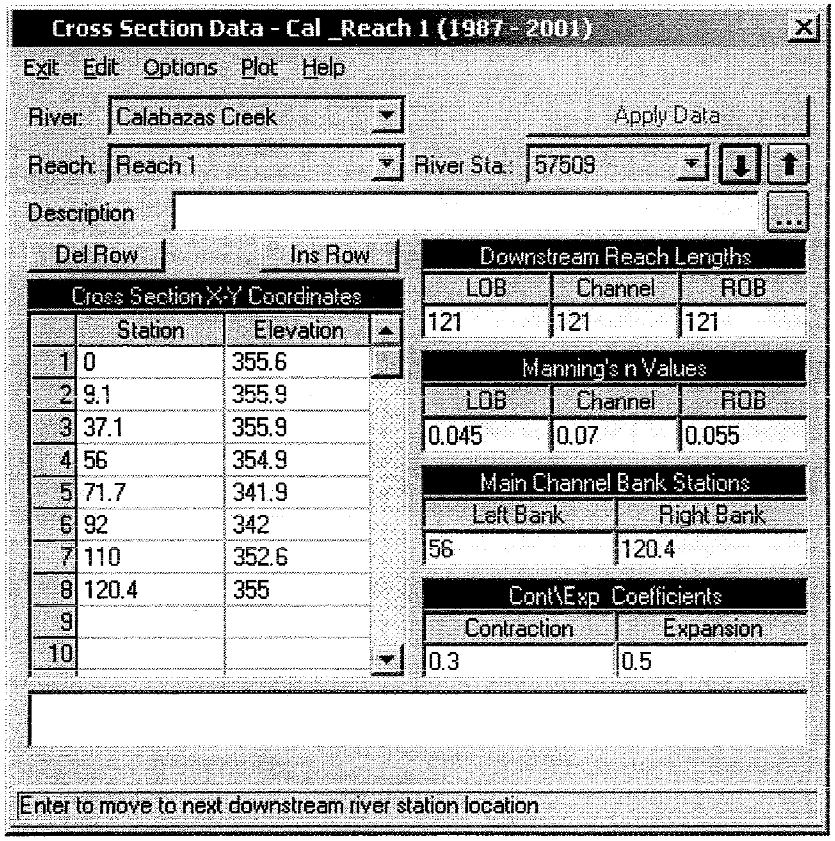
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 57558



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57509

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 355.6 |
| 2 | 9.1 | 355.9 |
| 3 | 37.1 | 355.9 |
| 4 | 56 | 354.9 |
| 5 | 71.7 | 341.9 |
| 6 | 92 | 342 |
| 7 | 110 | 352.6 |
| 8 | 120.4 | 355 |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 121 | 121 | 121 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

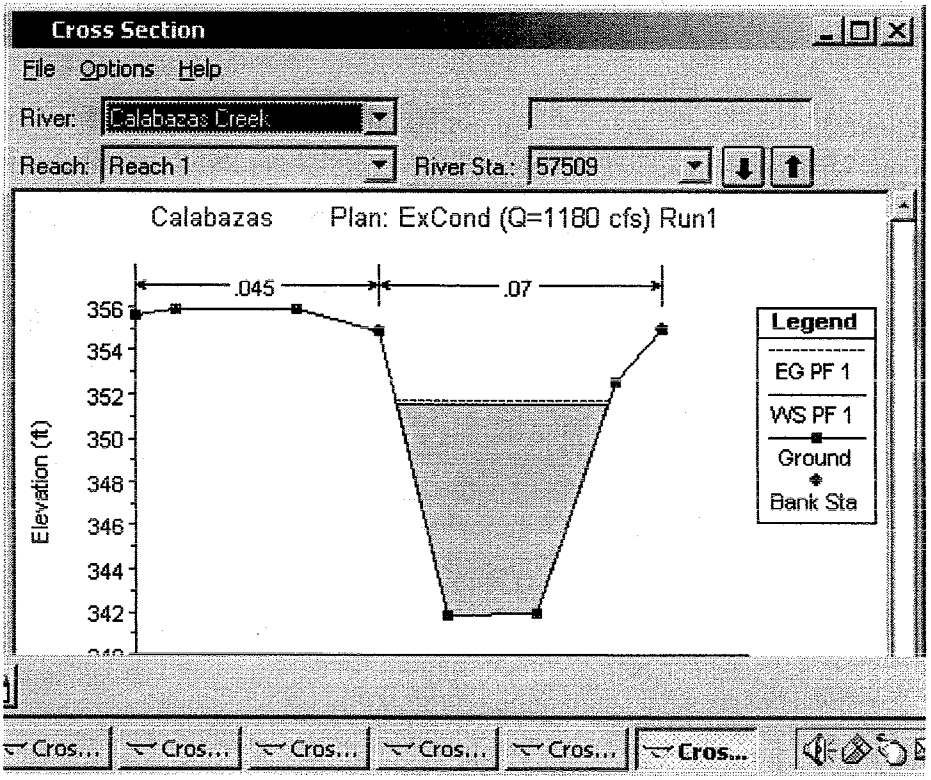
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 56 | 120.4 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

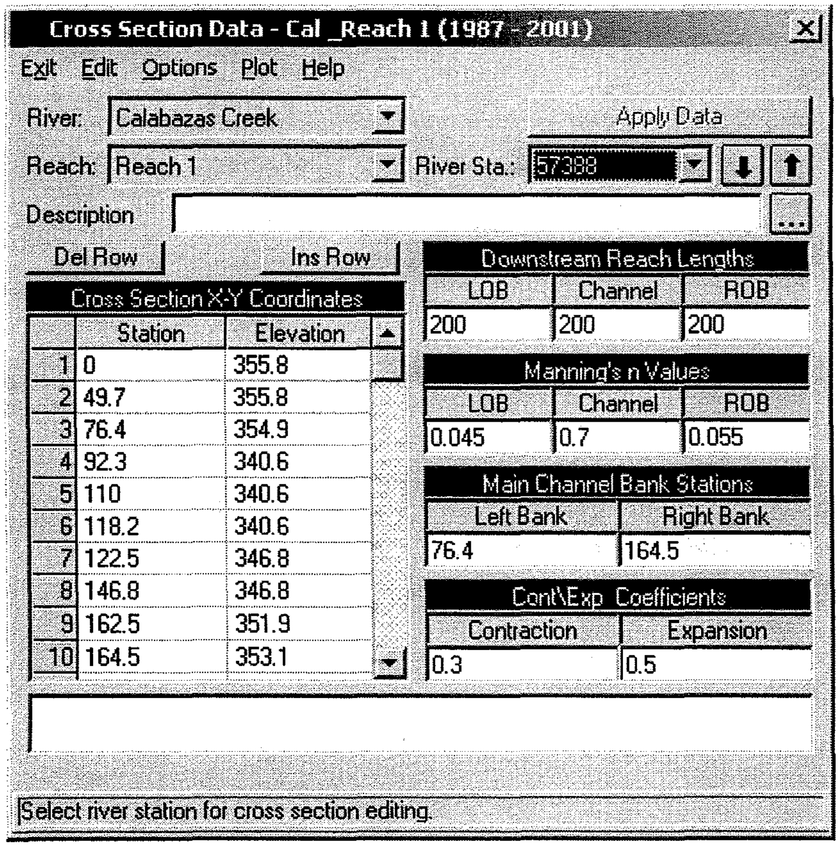


**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57509



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57388

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 355.8 |
| 2 | 49.7 | 355.8 |
| 3 | 76.4 | 354.9 |
| 4 | 92.3 | 340.6 |
| 5 | 110 | 340.6 |
| 6 | 118.2 | 340.6 |
| 7 | 122.5 | 346.8 |
| 8 | 146.8 | 346.8 |
| 9 | 162.5 | 351.9 |
| 10 | 164.5 | 353.1 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 200 | 200 | 200 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.7 | 0.055 |

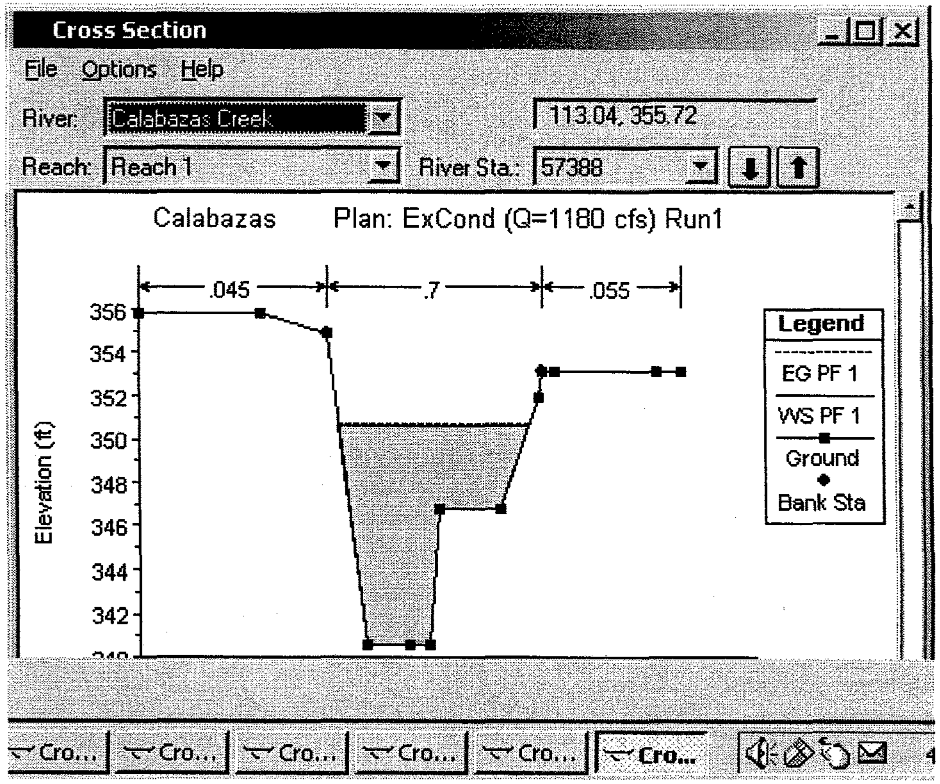
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 76.4 | 164.5 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Select river station for cross section editing.



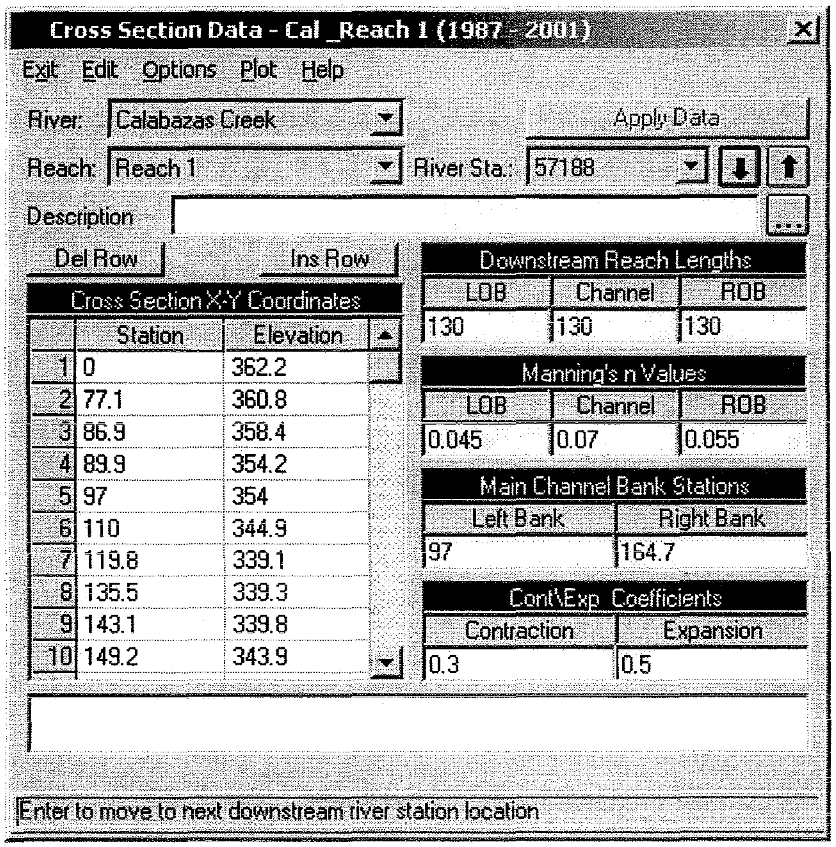
**Cross Section**

River: Calabazas Creek

113.04, 355.72

Reach: Reach 1

River Sta.: 57388



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57188

Description

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 362.2 |
| 2 | 77.1 | 360.8 |
| 3 | 86.9 | 358.4 |
| 4 | 89.9 | 354.2 |
| 5 | 97 | 354 |
| 6 | 110 | 344.9 |
| 7 | 119.8 | 339.1 |
| 8 | 135.5 | 339.3 |
| 9 | 143.1 | 339.8 |
| 10 | 149.2 | 343.9 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 130 | 130 | 130 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

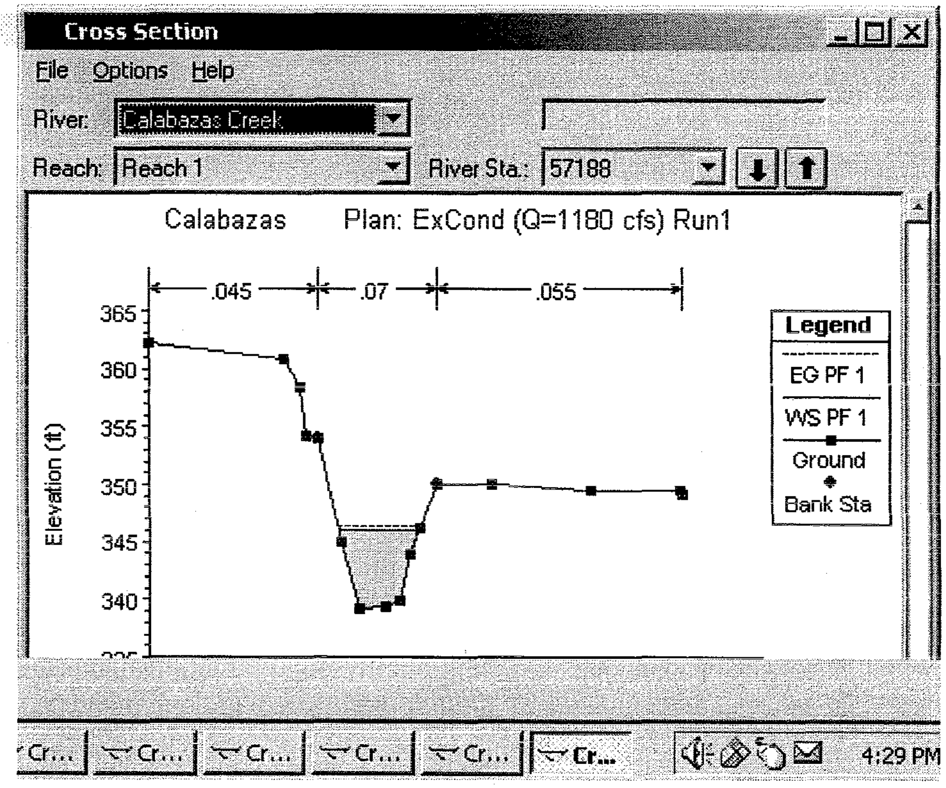
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 97 | 164.7 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

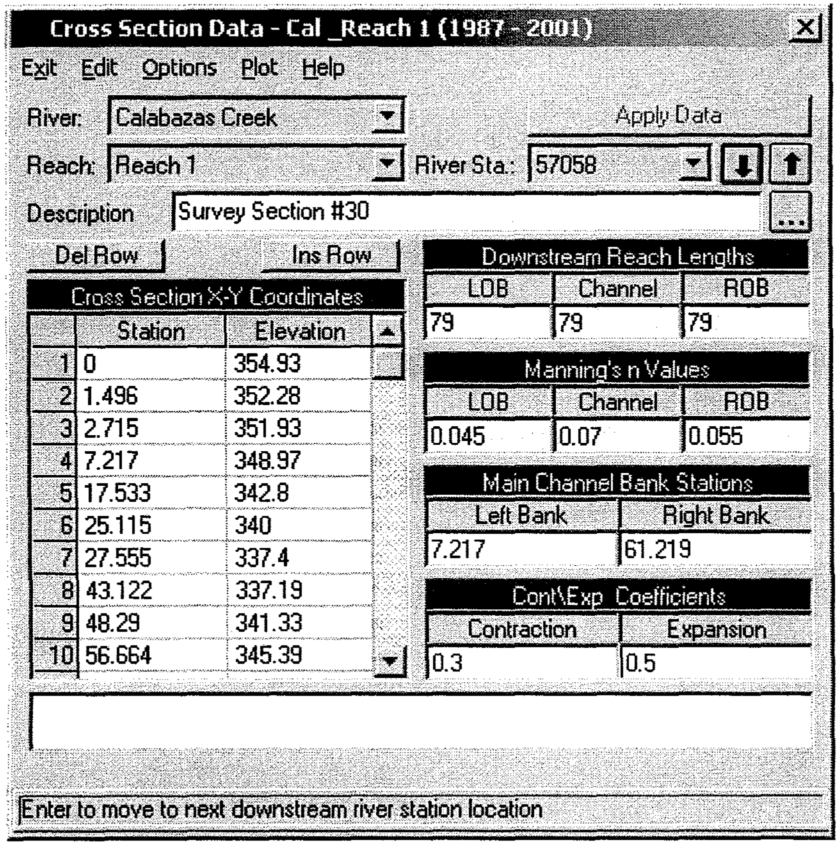


**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 57188



River: Calabazas Creek

Reach: Reach 1

River Sta.: 57058

Description: Survey Section #30

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 354.93 |
| 2 | 1.496 | 352.28 |
| 3 | 2.715 | 351.93 |
| 4 | 7.217 | 348.97 |
| 5 | 17.533 | 342.8 |
| 6 | 25.115 | 340 |
| 7 | 27.555 | 337.4 |
| 8 | 43.122 | 337.19 |
| 9 | 48.29 | 341.33 |
| 10 | 56.664 | 345.39 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 79 | 79 | 79 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

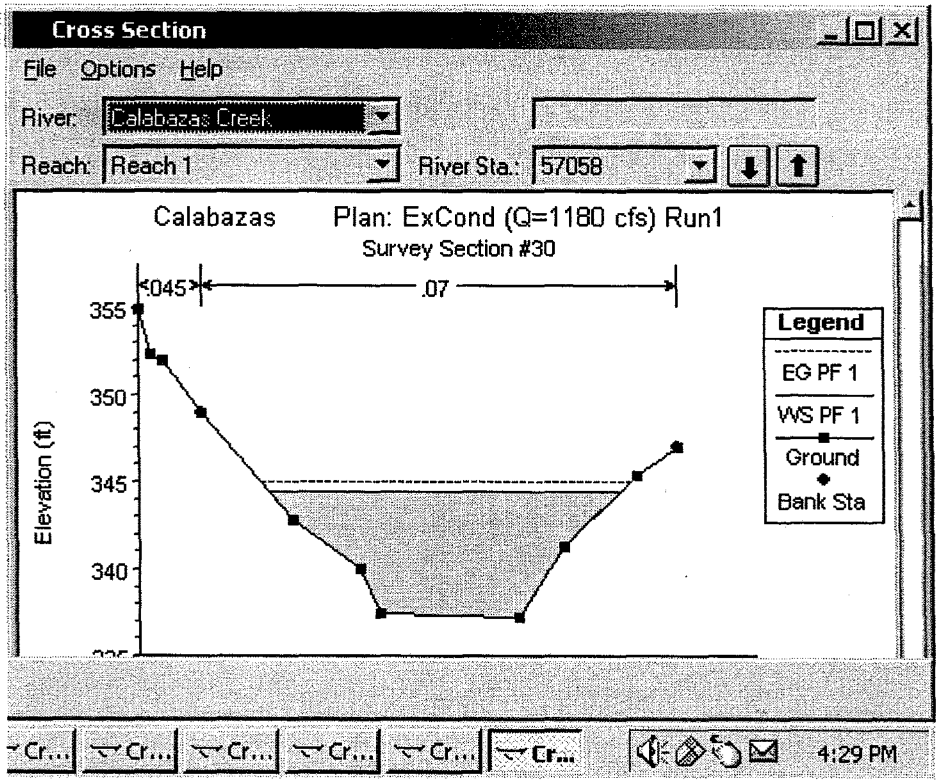
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 7.217 | 61.219 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

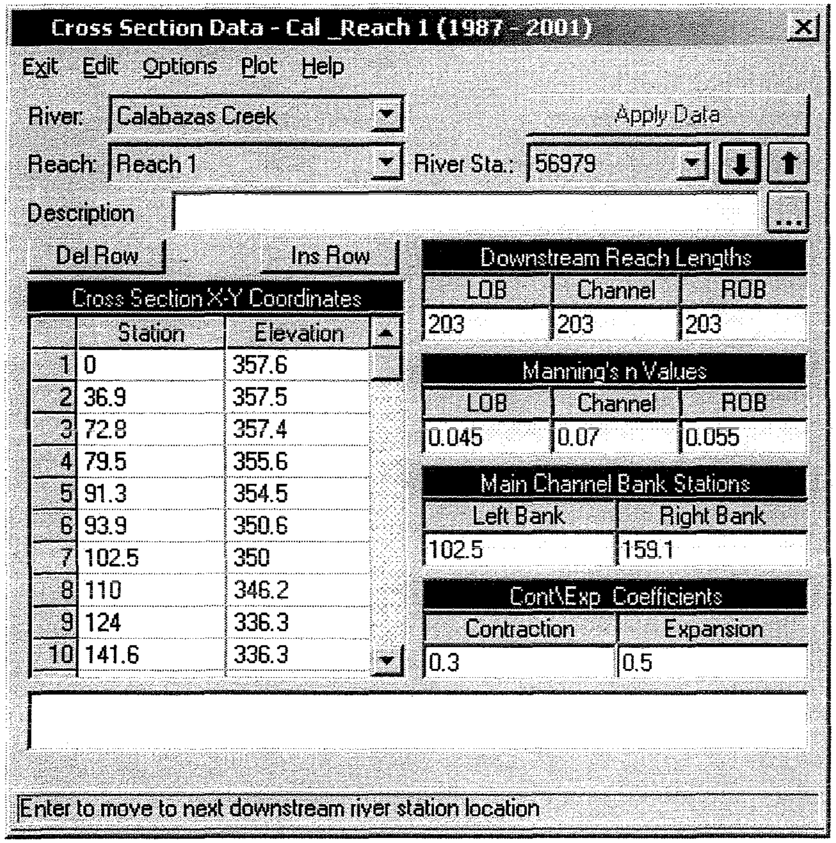
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 57058



Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Description
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56979

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 357.6 |
| 2 | 36.9 | 357.5 |
| 3 | 72.8 | 357.4 |
| 4 | 79.5 | 355.6 |
| 5 | 91.3 | 354.5 |
| 6 | 93.9 | 350.6 |
| 7 | 102.5 | 350 |
| 8 | 110 | 346.2 |
| 9 | 124 | 336.3 |
| 10 | 141.6 | 336.3 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 203 | 203 | 203 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

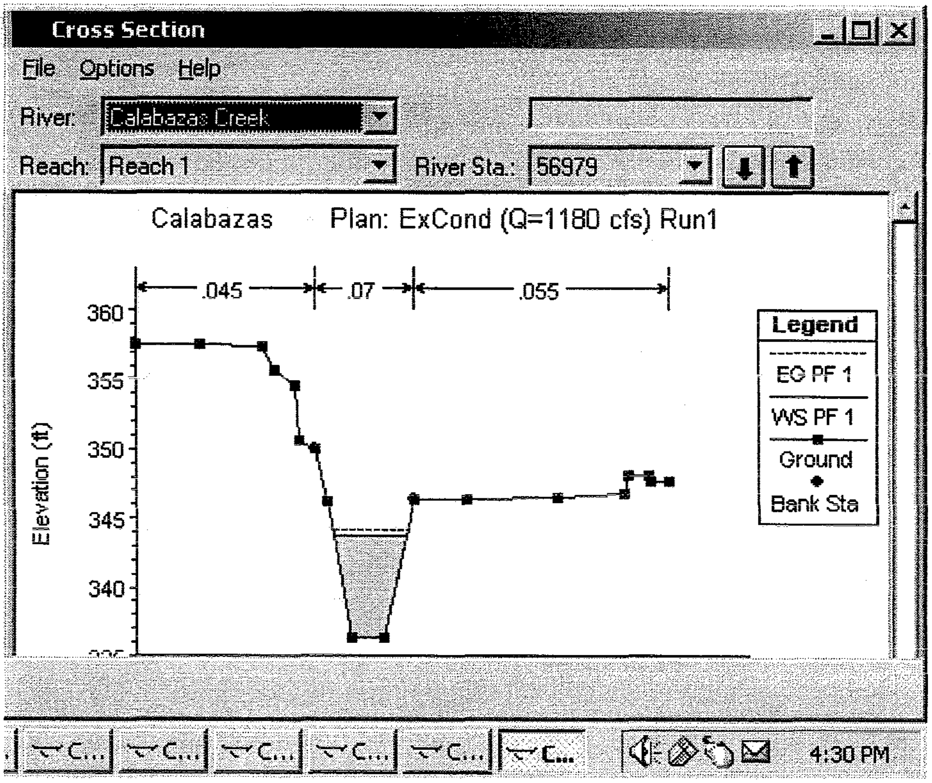
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 102.5 | 159.1 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

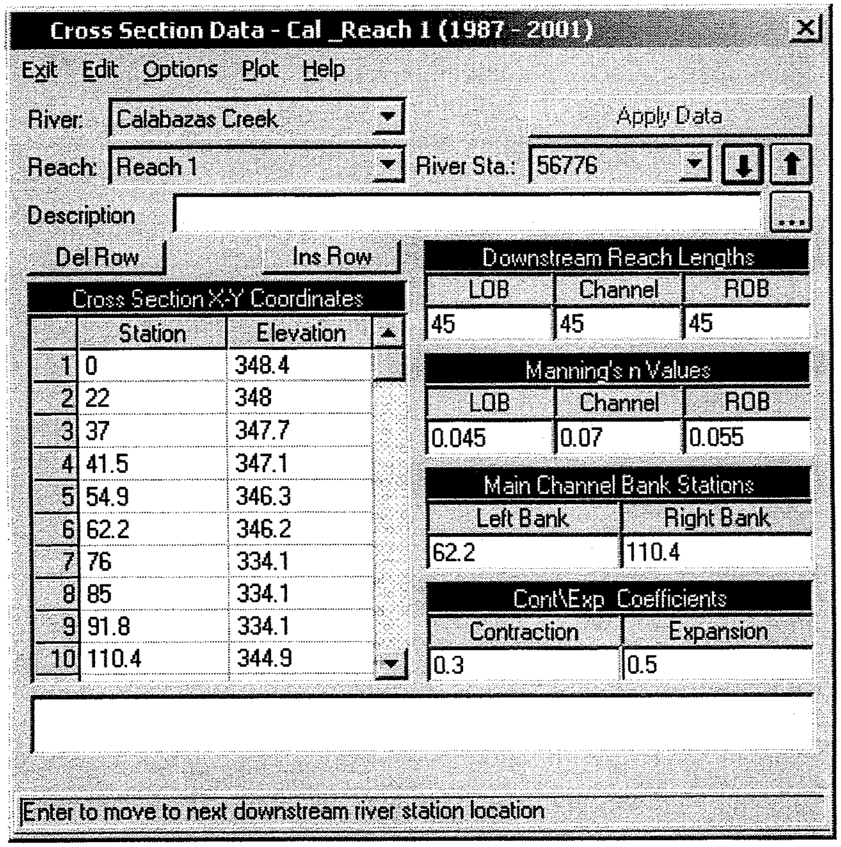
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56979



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56776

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 348.4 |
| 2 | 22 | 348 |
| 3 | 37 | 347.7 |
| 4 | 41.5 | 347.1 |
| 5 | 54.9 | 346.3 |
| 6 | 62.2 | 346.2 |
| 7 | 76 | 334.1 |
| 8 | 85 | 334.1 |
| 9 | 91.8 | 334.1 |
| 10 | 110.4 | 344.9 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 45 | 45 | 45 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

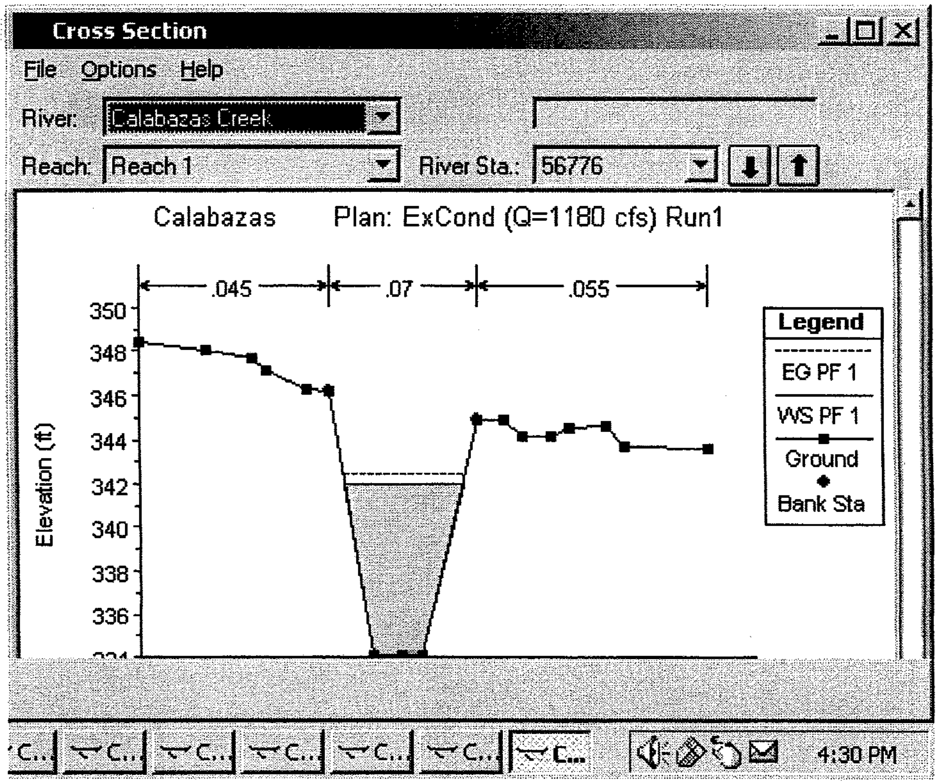
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 62.2 | 110.4 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

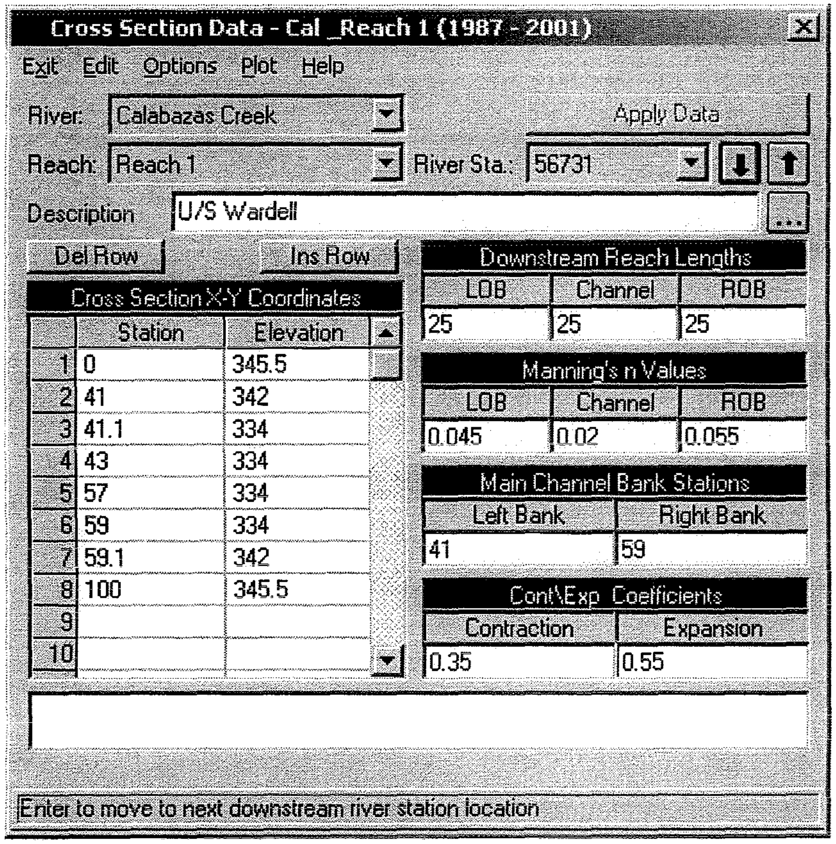
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56776



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56731

Description: U/S Wardell

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 345.5 |
| 2 | 41 | 342 |
| 3 | 41.1 | 334 |
| 4 | 43 | 334 |
| 5 | 57 | 334 |
| 6 | 59 | 334 |
| 7 | 59.1 | 342 |
| 8 | 100 | 345.5 |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 25 | 25 | 25 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.02 | 0.055 |

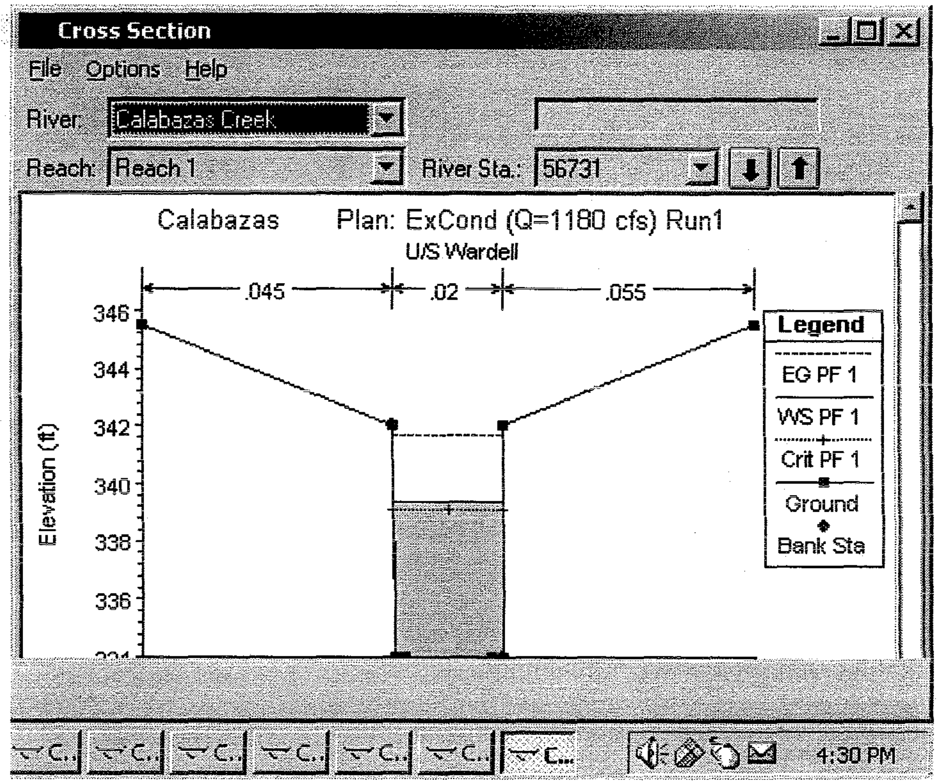
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 41 | 59 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.35 | 0.55 |

Enter to move to next downstream river station location



**Cross Section**

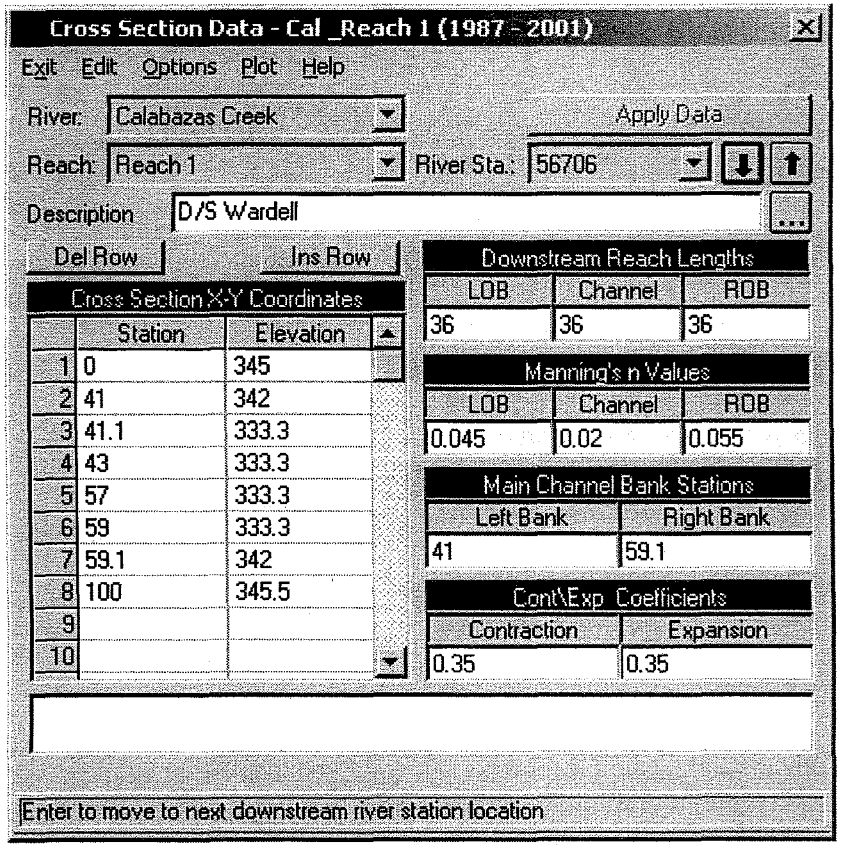
River: Calabazas Creek

Reach: Reach 1

River Sta.: 56731

Calabazas Plan: ExCond (Q=1180 cfs) Run1

U/S Wardell



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56706

Description: D/S Wardell

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 345 |
| 2 | 41 | 342 |
| 3 | 41.1 | 333.3 |
| 4 | 43 | 333.3 |
| 5 | 57 | 333.3 |
| 6 | 59 | 333.3 |
| 7 | 59.1 | 342 |
| 8 | 100 | 345.5 |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 36 | 36 | 36 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.02 | 0.055 |

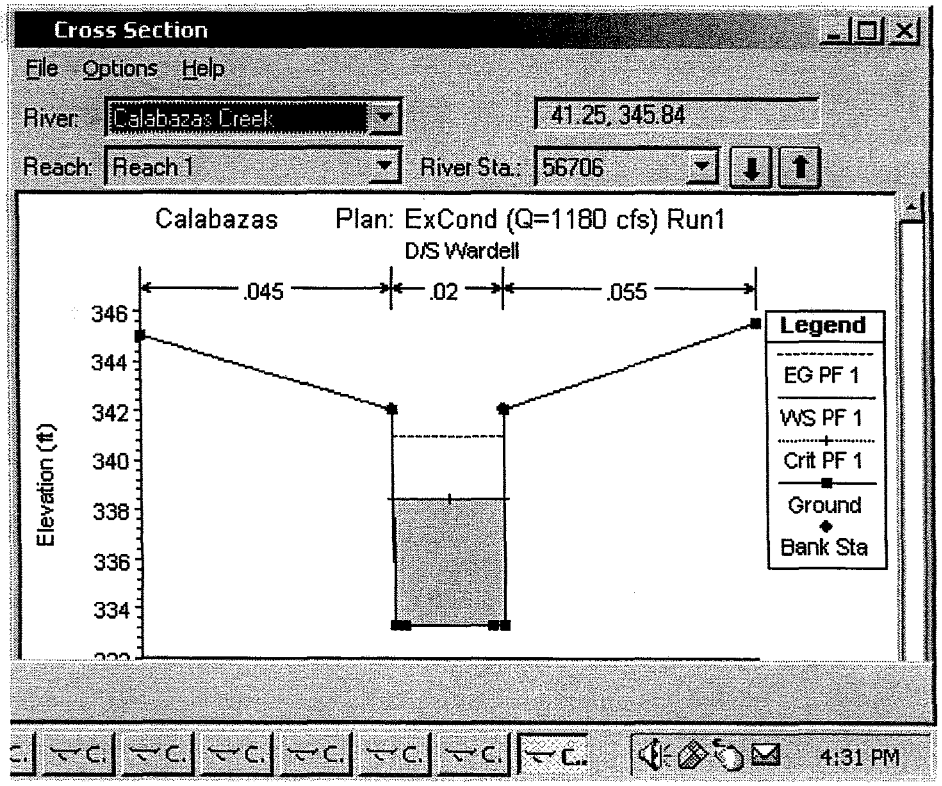
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 41 | 59.1 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.35 | 0.35 |

Enter to move to next downstream river station location

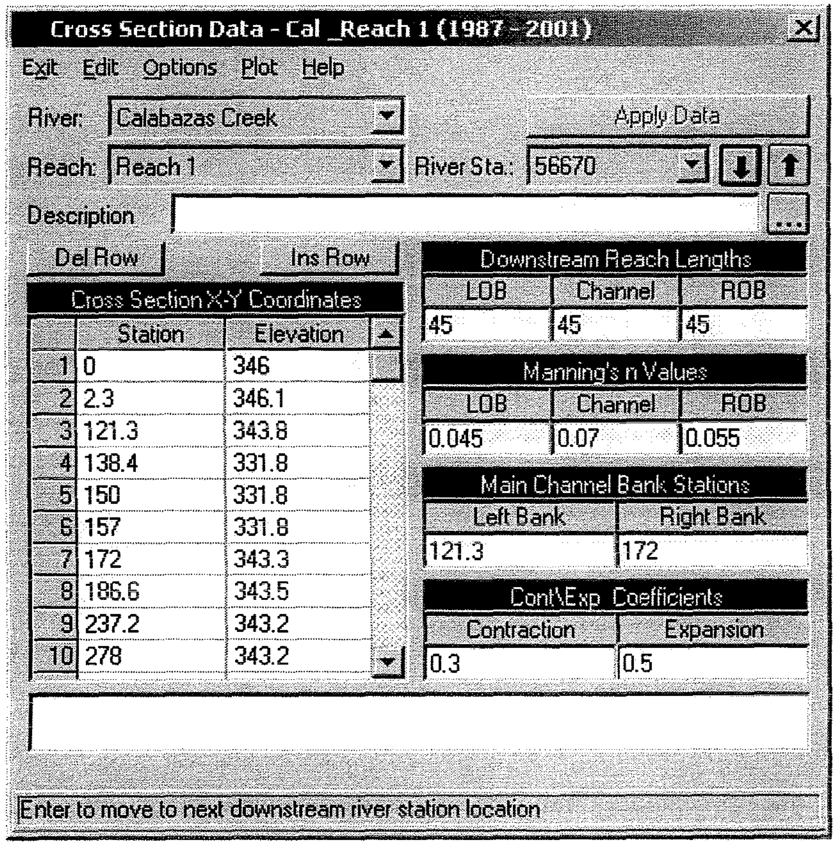


River: Calabazas Creek

41.25, 345.84

Reach: Reach 1

River Sta.: 56706



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56670

Description

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 346 |
| 2 | 2.3 | 346.1 |
| 3 | 121.3 | 343.8 |
| 4 | 138.4 | 331.8 |
| 5 | 150 | 331.8 |
| 6 | 157 | 331.8 |
| 7 | 172 | 343.3 |
| 8 | 186.6 | 343.5 |
| 9 | 237.2 | 343.2 |
| 10 | 278 | 343.2 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 45 | 45 | 45 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

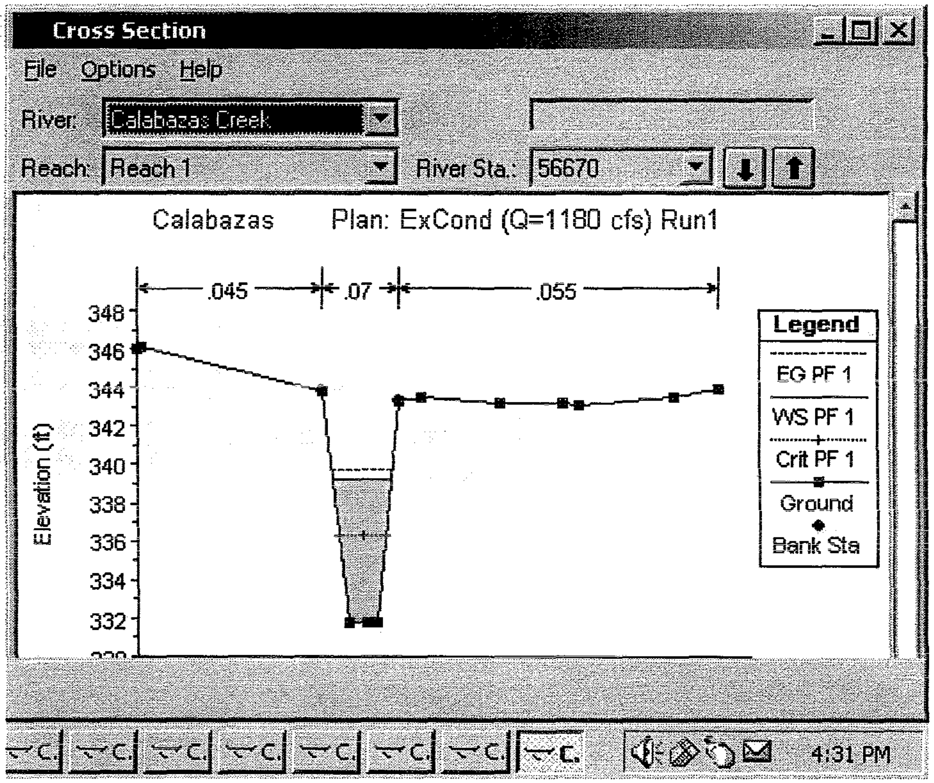
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 121.3 | 172 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

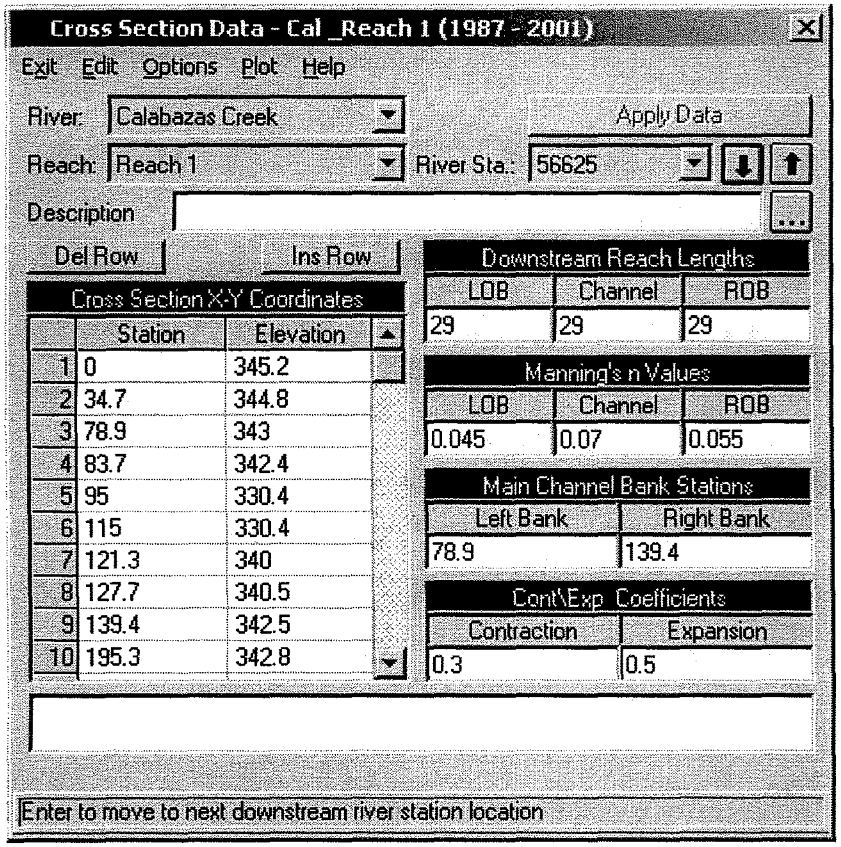
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56670



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56625

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 345.2 |
| 2 | 34.7 | 344.8 |
| 3 | 78.9 | 343 |
| 4 | 83.7 | 342.4 |
| 5 | 95 | 330.4 |
| 6 | 115 | 330.4 |
| 7 | 121.3 | 340 |
| 8 | 127.7 | 340.5 |
| 9 | 139.4 | 342.5 |
| 10 | 195.3 | 342.8 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 29 | 29 | 29 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

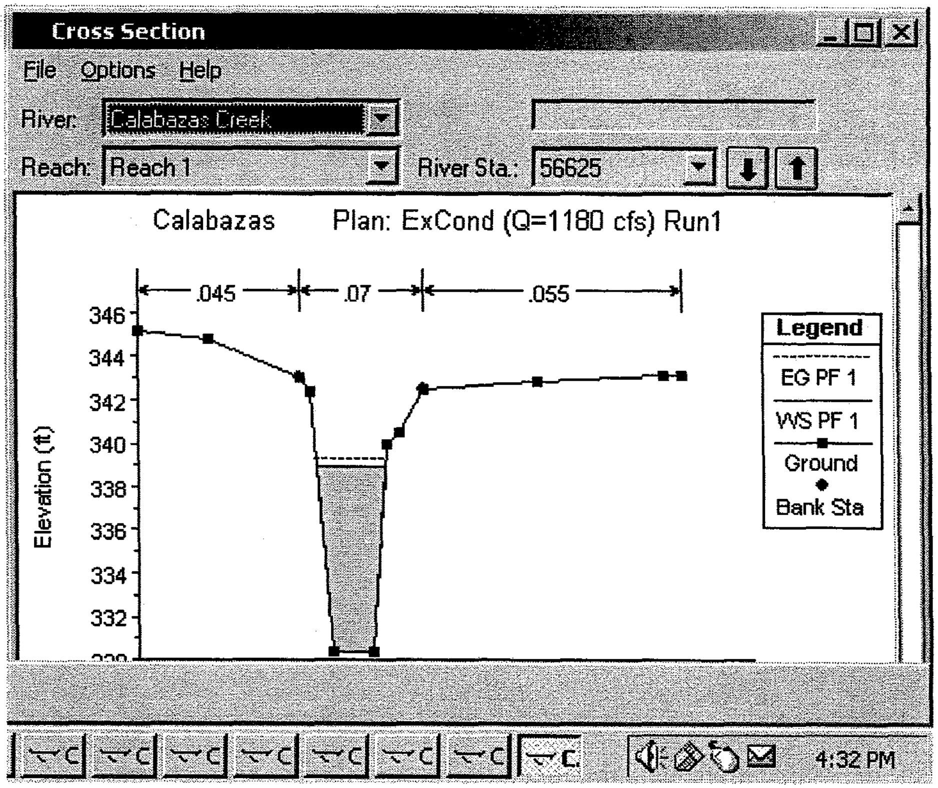
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 78.9 | 139.4 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

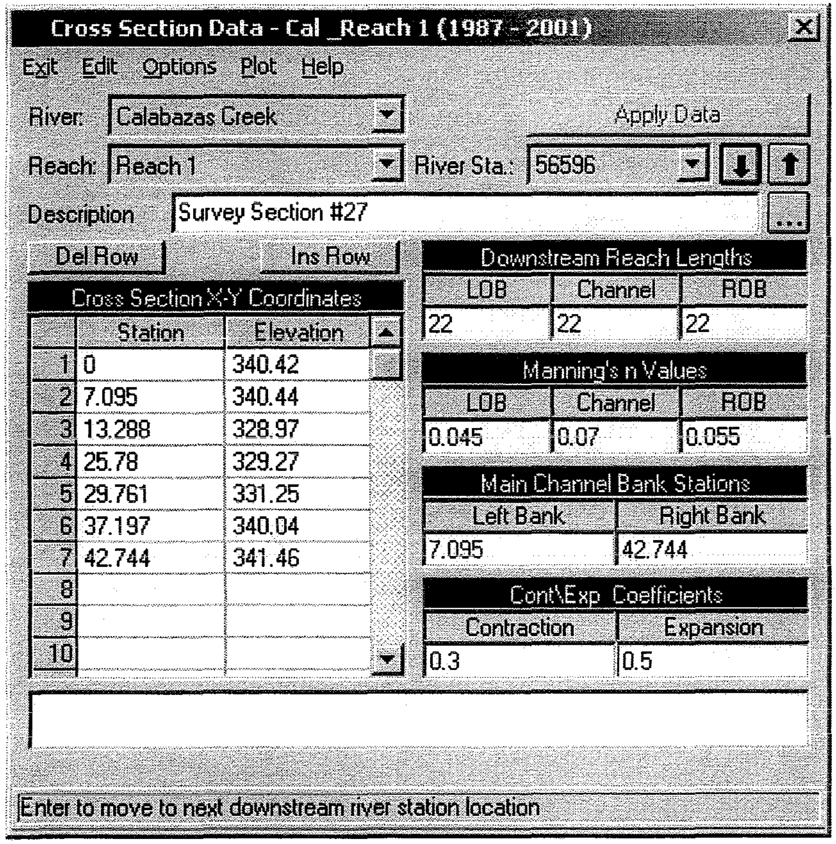
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56625


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row
Enter to move to next downstream river station location

River: Calabazas Creek

Reach: Reach 1 River Sta.: 56596

Description: Survey Section #27

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 340.42 |
| 2 | 7.095 | 340.44 |
| 3 | 13.288 | 328.97 |
| 4 | 25.78 | 329.27 |
| 5 | 29.761 | 331.25 |
| 6 | 37.197 | 340.04 |
| 7 | 42.744 | 341.46 |
| 8 | | |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 22 | 22 | 22 |

Manning's n Values

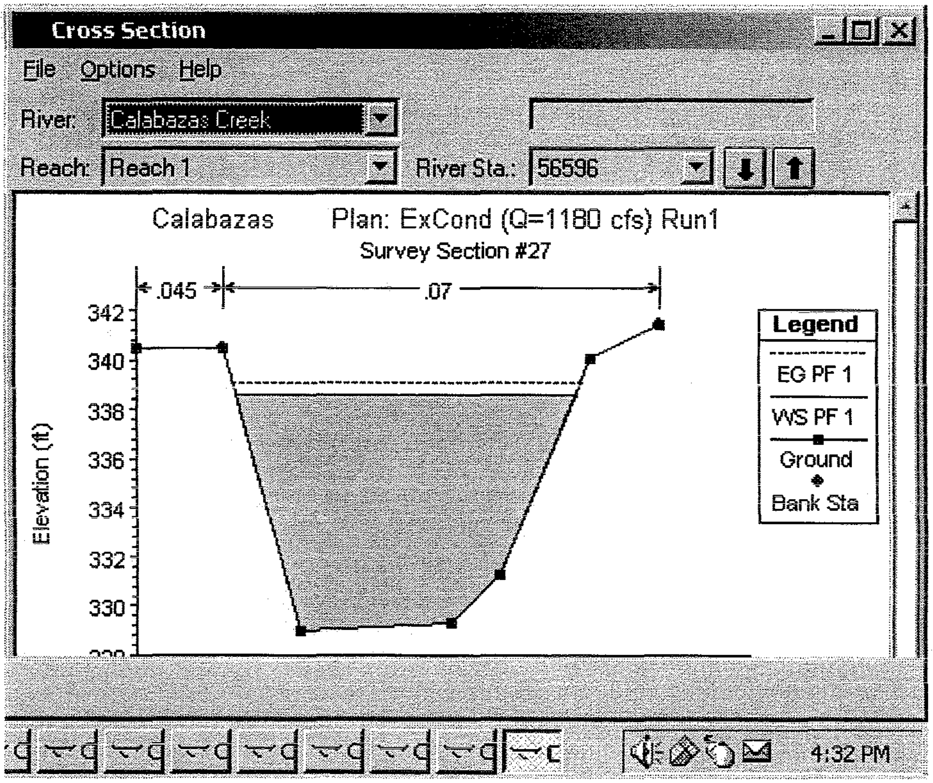
| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 7.095 | 42.744 |

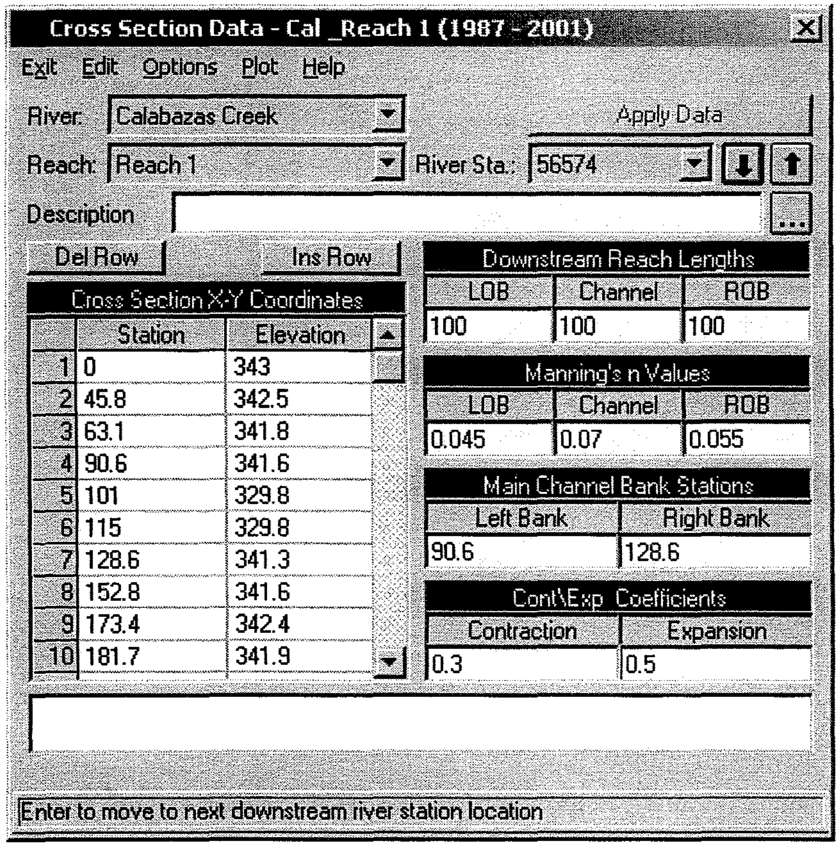
Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |



River: Calabazas Creek

Reach: Reach 1 River Sta.: 56596



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56574

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 343 |
| 2 | 45.8 | 342.5 |
| 3 | 63.1 | 341.8 |
| 4 | 90.6 | 341.6 |
| 5 | 101 | 329.8 |
| 6 | 115 | 329.8 |
| 7 | 128.6 | 341.3 |
| 8 | 152.8 | 341.6 |
| 9 | 173.4 | 342.4 |
| 10 | 181.7 | 341.9 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

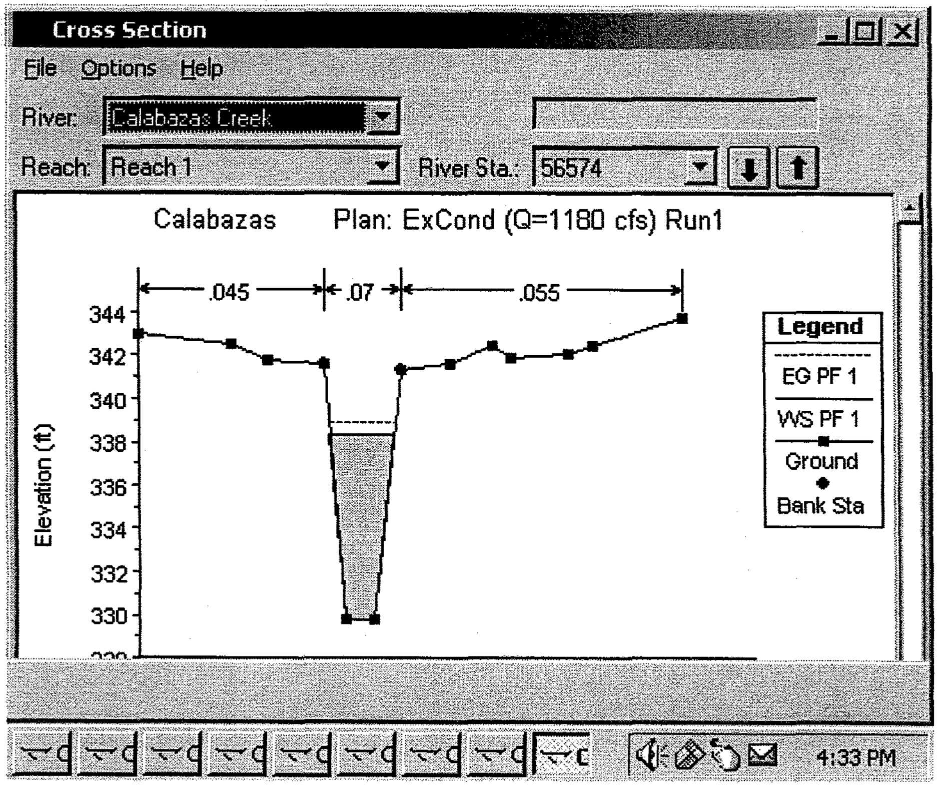
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 90.6 | 128.6 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

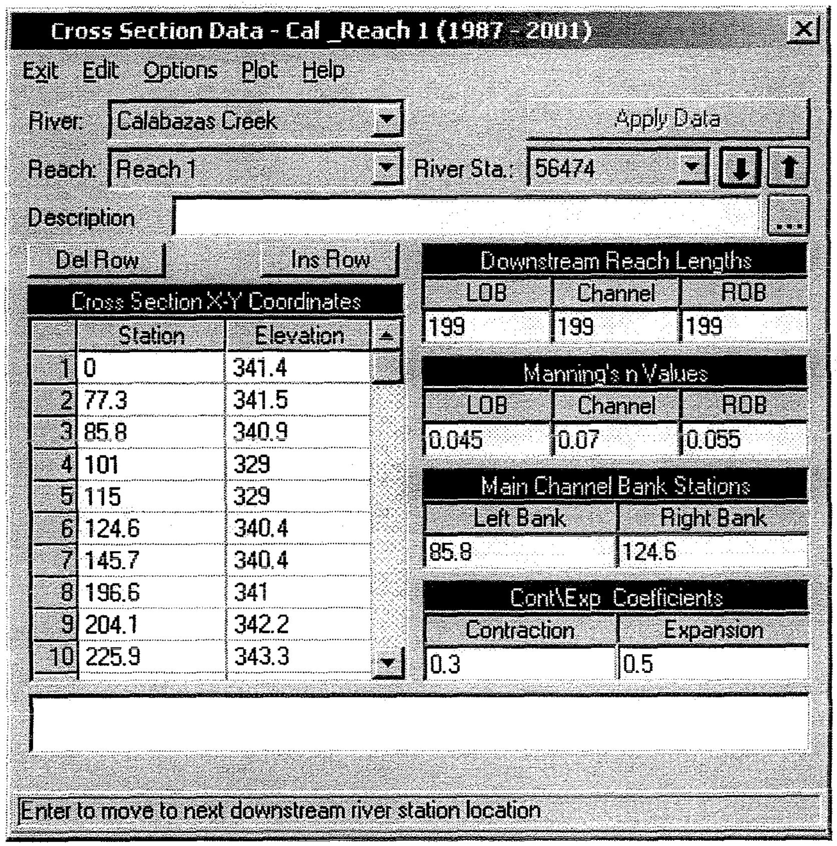
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56574



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56474

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 341.4 |
| 2 | 77.3 | 341.5 |
| 3 | 85.8 | 340.9 |
| 4 | 101 | 329 |
| 5 | 115 | 329 |
| 6 | 124.6 | 340.4 |
| 7 | 145.7 | 340.4 |
| 8 | 196.6 | 341 |
| 9 | 204.1 | 342.2 |
| 10 | 225.9 | 343.3 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 199 | 199 | 199 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

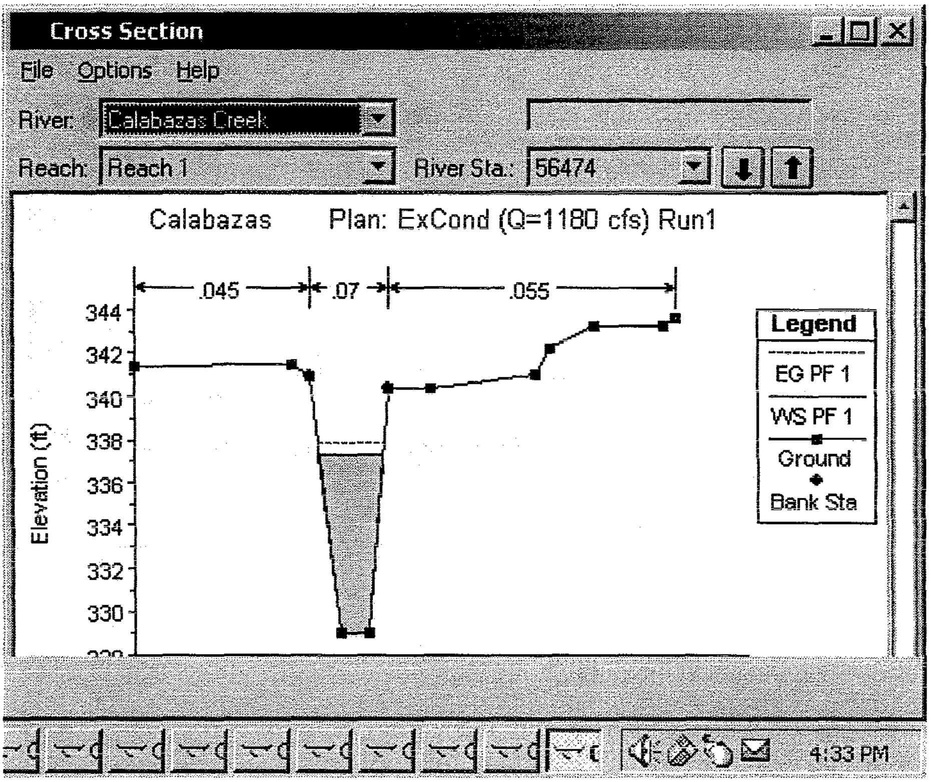
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 85.8 | 124.6 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location



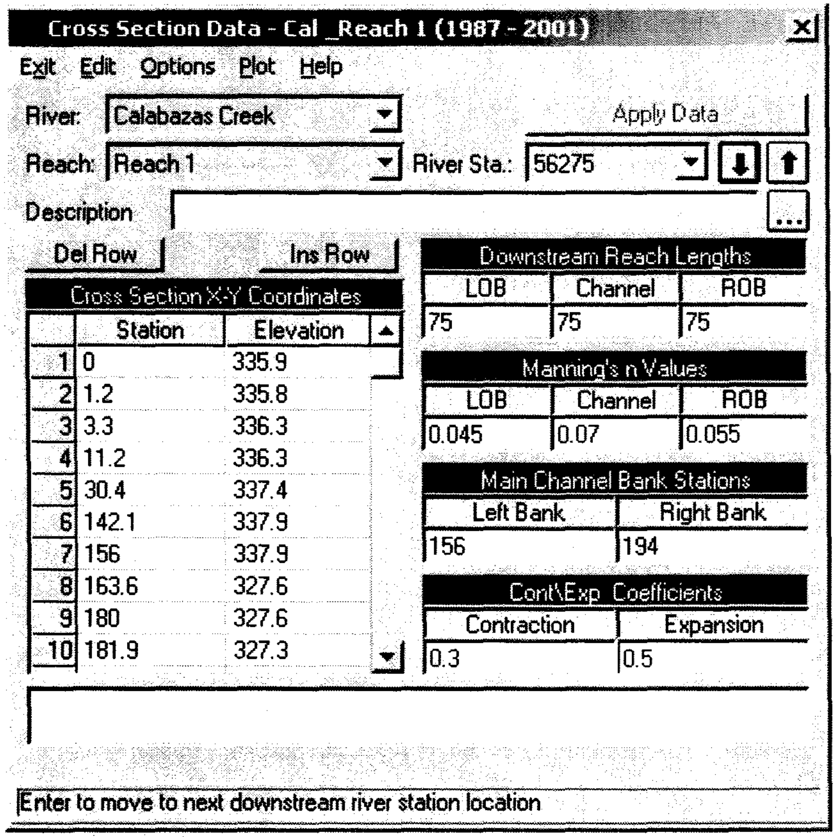
**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56474

Calabazas Plan: ExCond (Q=1180 cfs) Run1



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56275

Description

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 335.9 |
| 2 | 1.2 | 335.8 |
| 3 | 3.3 | 336.3 |
| 4 | 11.2 | 336.3 |
| 5 | 30.4 | 337.4 |
| 6 | 142.1 | 337.9 |
| 7 | 156 | 337.9 |
| 8 | 163.6 | 327.6 |
| 9 | 180 | 327.6 |
| 10 | 181.9 | 327.3 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 75 | 75 | 75 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

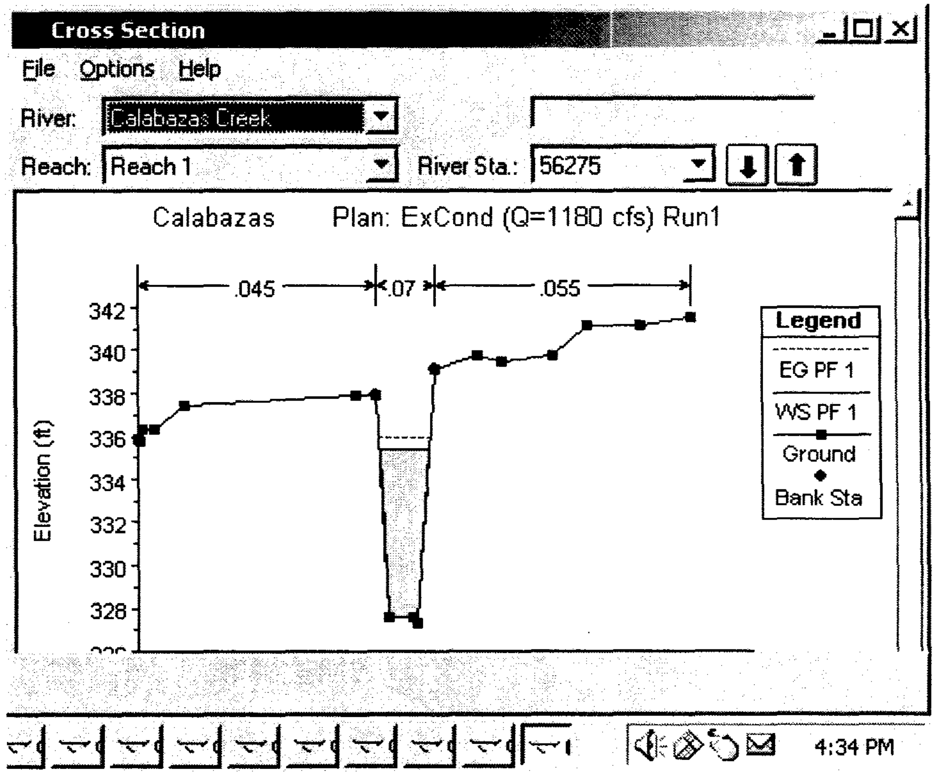
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 156 | 194 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

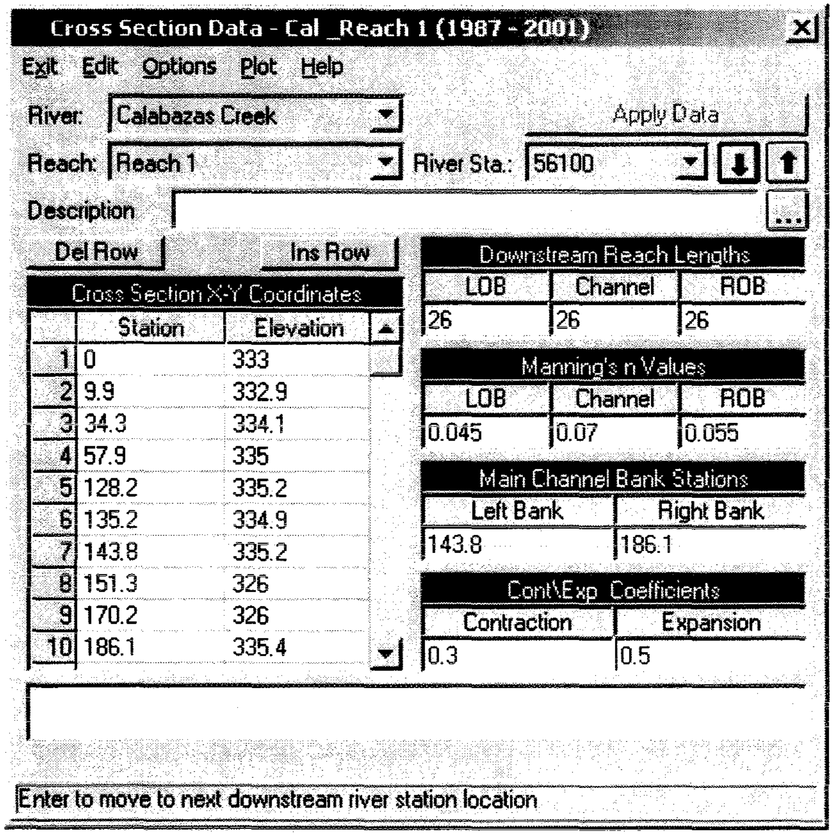
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56275



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56100

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 333 |
| 2 | 9.9 | 332.9 |
| 3 | 34.3 | 334.1 |
| 4 | 57.9 | 335 |
| 5 | 128.2 | 335.2 |
| 6 | 135.2 | 334.9 |
| 7 | 143.8 | 335.2 |
| 8 | 151.3 | 326 |
| 9 | 170.2 | 326 |
| 10 | 186.1 | 335.4 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 26 | 26 | 26 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

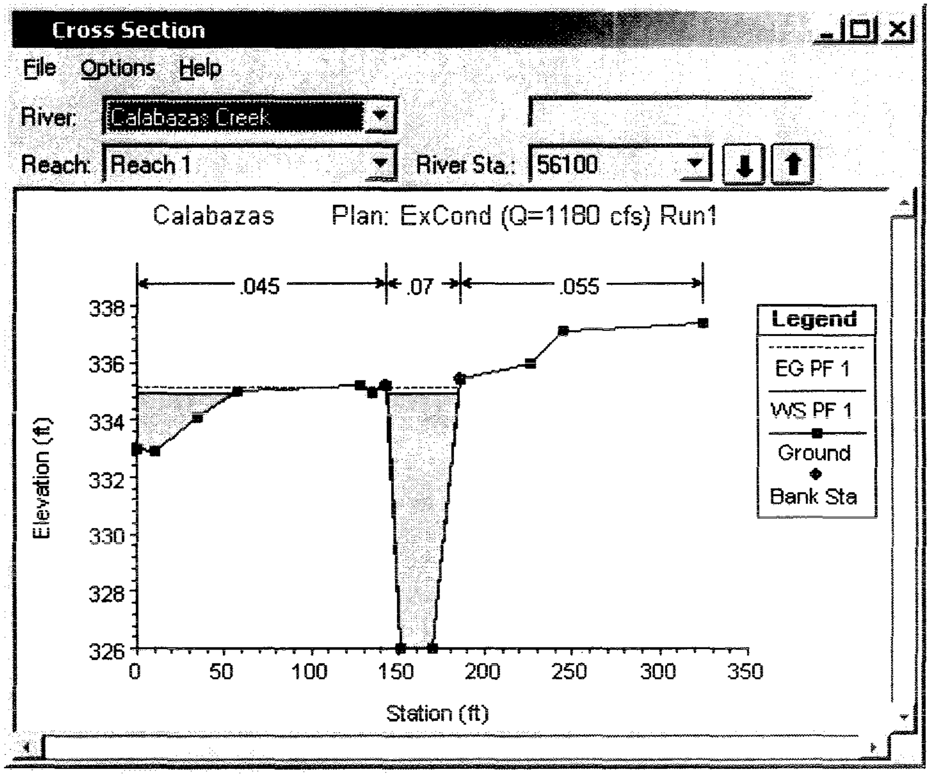
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 143.8 | 186.1 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

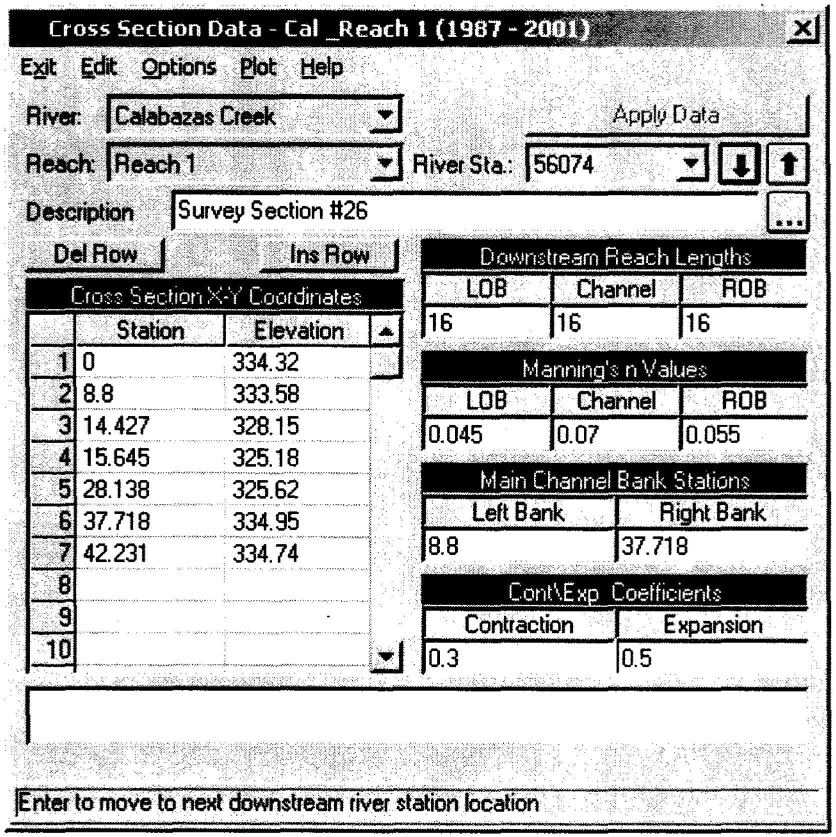
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56100



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56074

Description: Survey Section #26

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 334.32 |
| 2 | 8.8 | 333.58 |
| 3 | 14.427 | 328.15 |
| 4 | 15.645 | 325.18 |
| 5 | 28.138 | 325.62 |
| 6 | 37.718 | 334.95 |
| 7 | 42.231 | 334.74 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 16 | 16 | 16 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

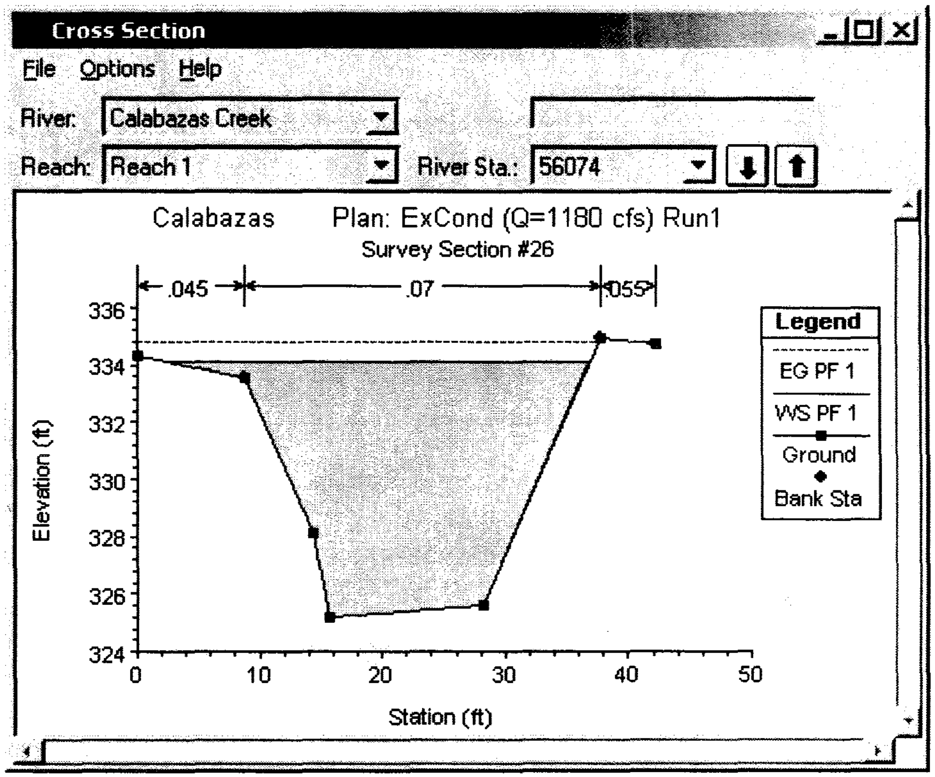
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 8.8 | 37.718 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

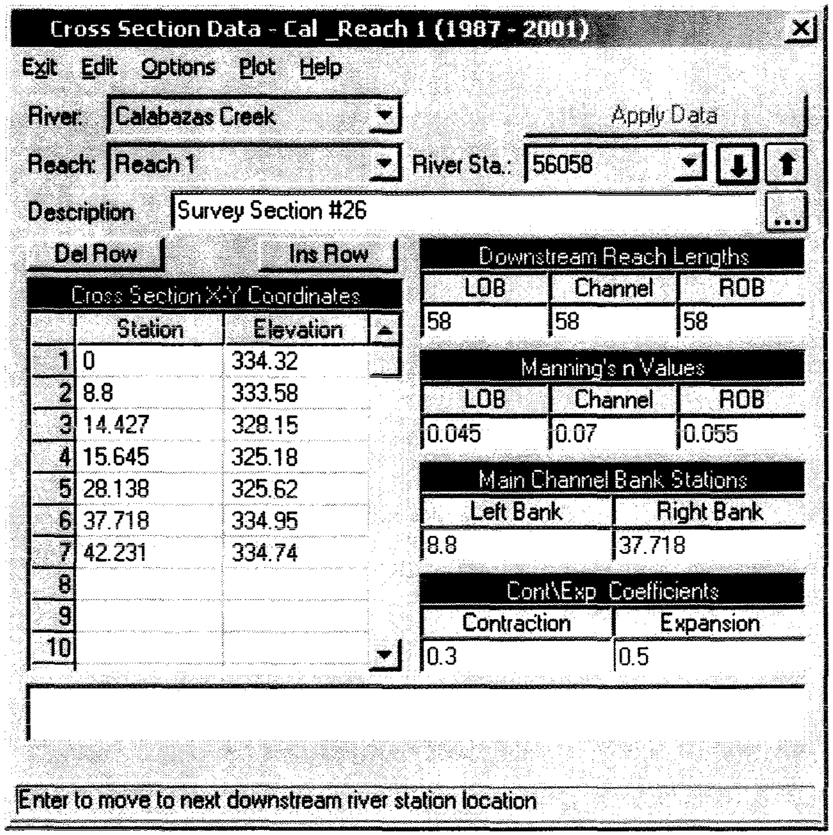
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 56074



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56058

Description: Survey Section #26

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 334.32 |
| 2 | 8.8 | 333.58 |
| 3 | 14.427 | 328.15 |
| 4 | 15.645 | 325.18 |
| 5 | 28.138 | 325.62 |
| 6 | 37.718 | 334.95 |
| 7 | 42.231 | 334.74 |
| 8 |  |  |
| 9 |  |  |
| 10 |  |  |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 58 | 58 | 58 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

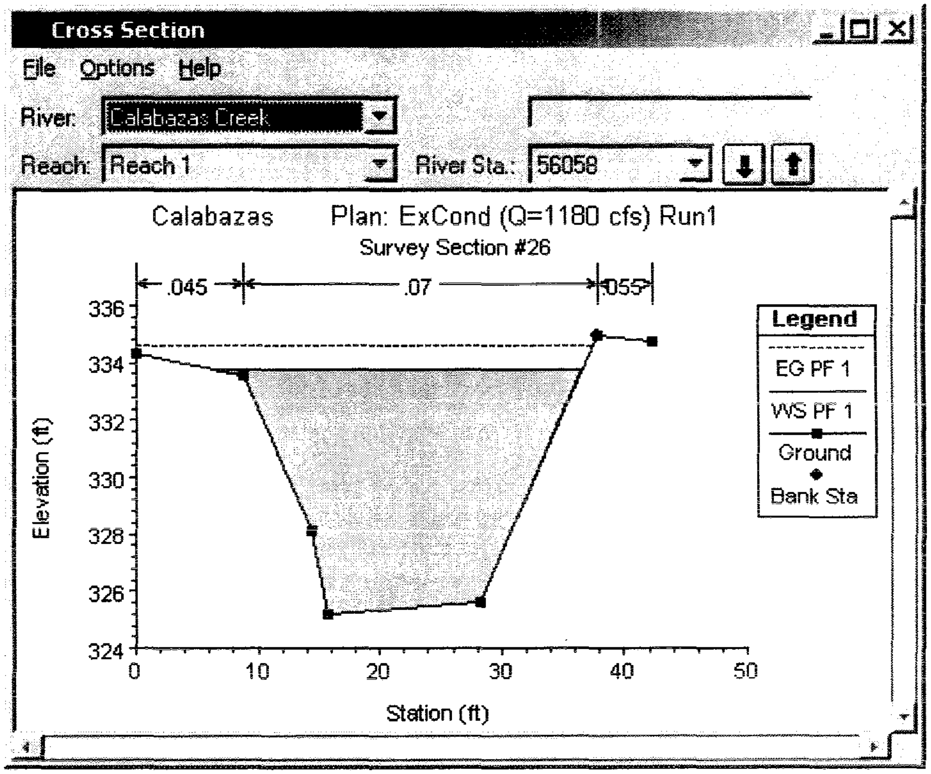
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 8.8 | 37.718 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

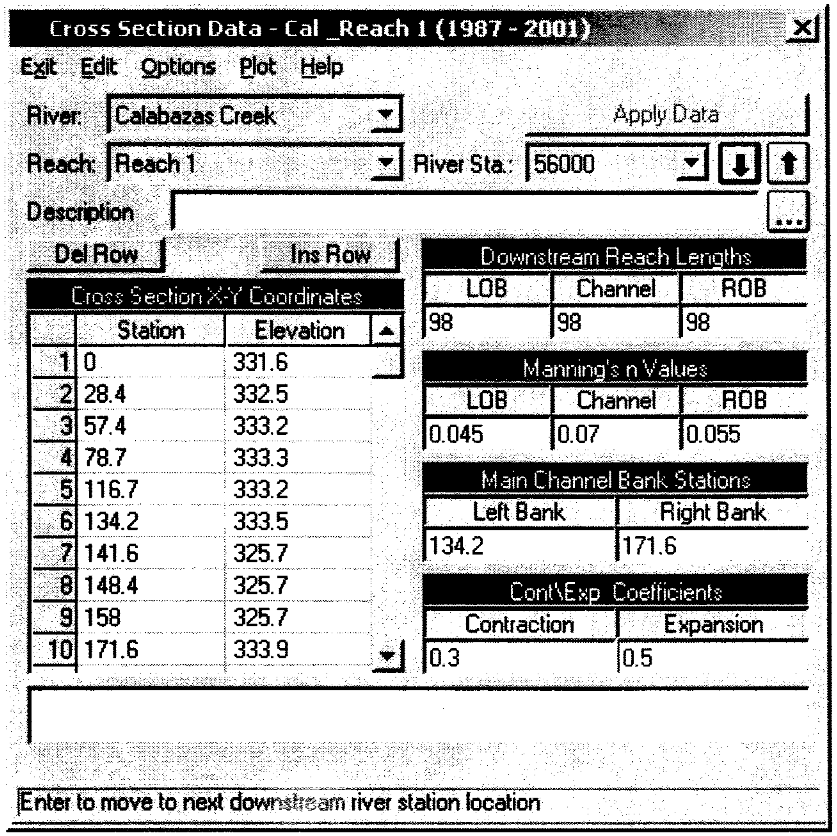


**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56058



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56000

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 331.6 |
| 2 | 28.4 | 332.5 |
| 3 | 57.4 | 333.2 |
| 4 | 78.7 | 333.3 |
| 5 | 116.7 | 333.2 |
| 6 | 134.2 | 333.5 |
| 7 | 141.6 | 325.7 |
| 8 | 148.4 | 325.7 |
| 9 | 158 | 325.7 |
| 10 | 171.6 | 333.9 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 98 | 98 | 98 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

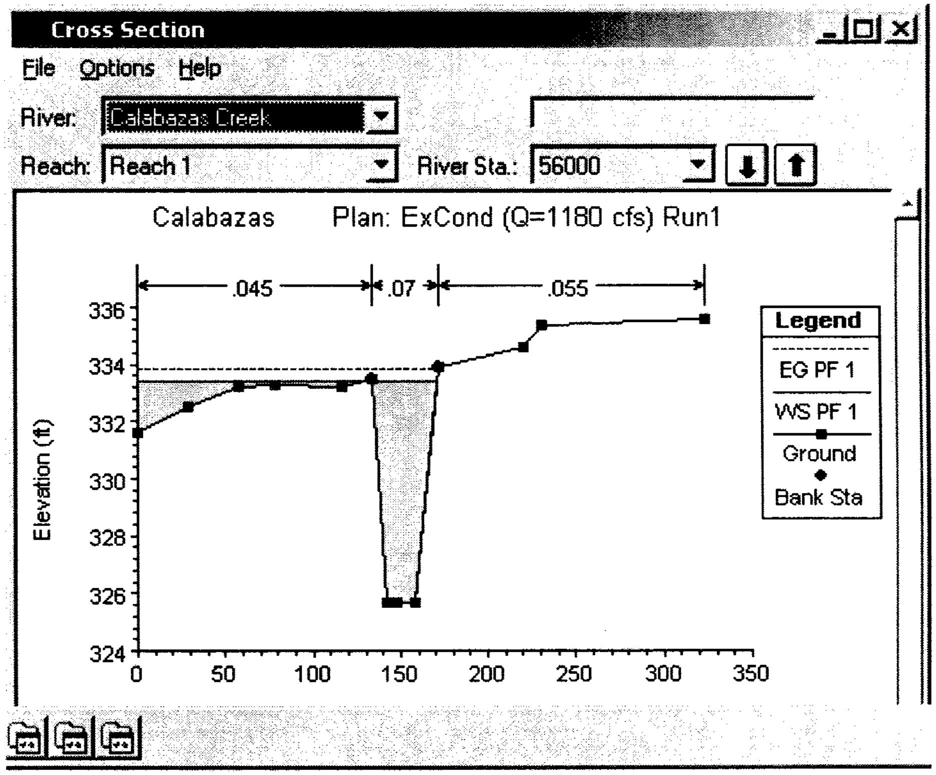
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 134.2 | 171.6 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

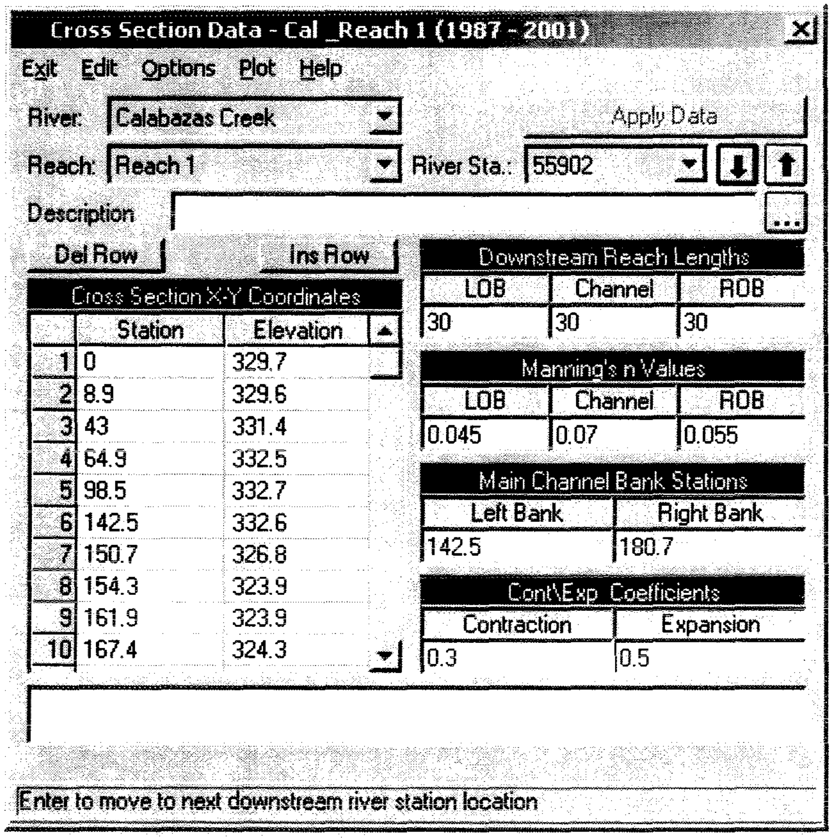


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 56000


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1 River Sta.: 55902

Description:

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 329.7 |
| 2 | 8.9 | 329.6 |
| 3 | 43 | 331.4 |
| 4 | 64.9 | 332.5 |
| 5 | 98.5 | 332.7 |
| 6 | 142.5 | 332.6 |
| 7 | 150.7 | 326.8 |
| 8 | 154.3 | 323.9 |
| 9 | 161.9 | 323.9 |
| 10 | 167.4 | 324.3 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 30 | 30 | 30 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

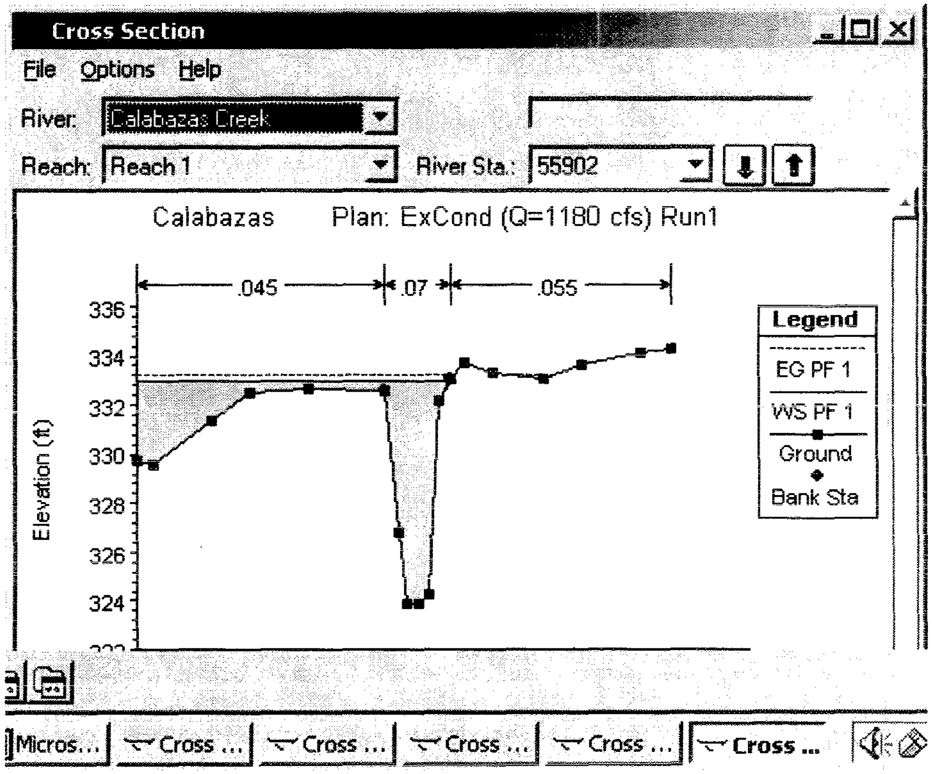
**Main Channel Bank Stations**

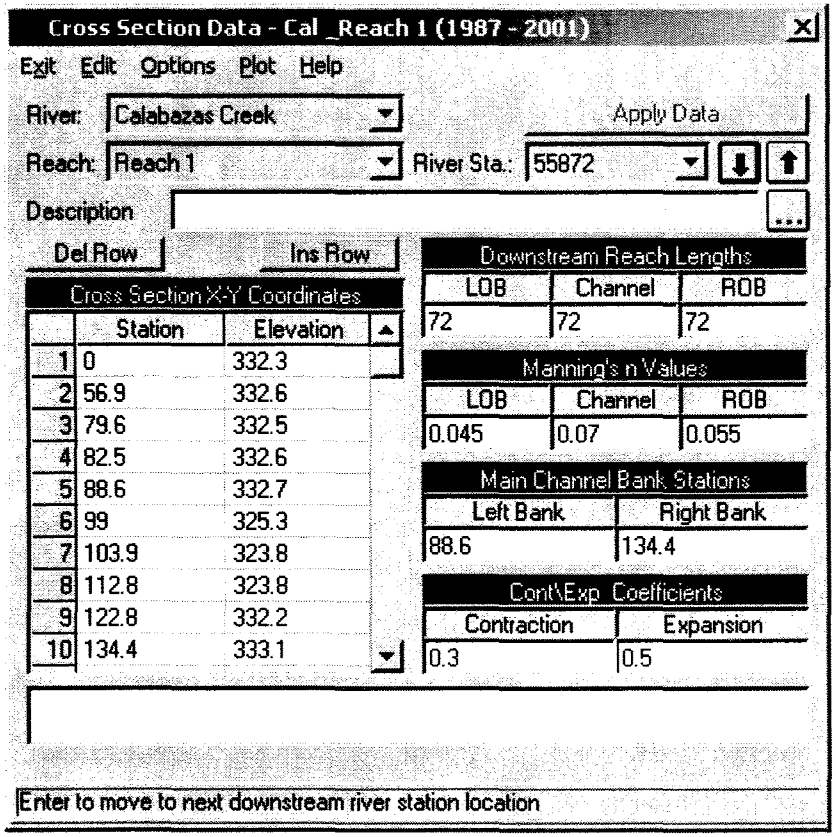
| Left Bank | Right Bank |
|---|---|
| 142.5 | 180.7 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location





**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55872

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 332.3 |
| 2 | 56.9 | 332.6 |
| 3 | 79.6 | 332.5 |
| 4 | 82.5 | 332.6 |
| 5 | 88.6 | 332.7 |
| 6 | 99 | 325.3 |
| 7 | 103.9 | 323.8 |
| 8 | 112.8 | 323.8 |
| 9 | 122.8 | 332.2 |
| 10 | 134.4 | 333.1 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 72 | 72 | 72 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

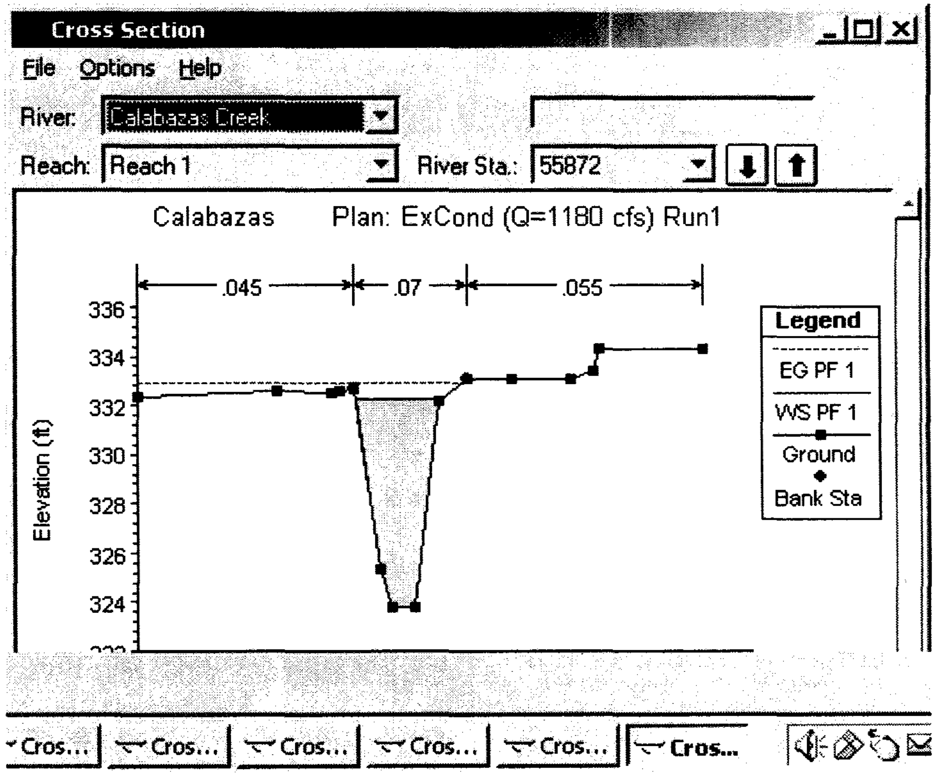
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 88.6 | 134.4 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location



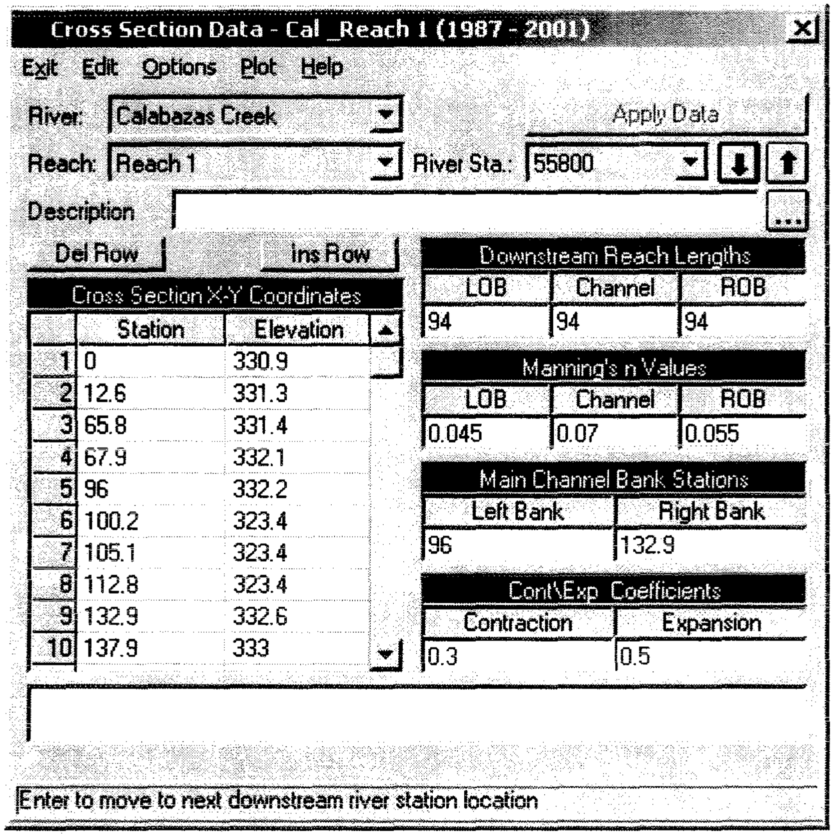
**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55872

Calabazas Plan: ExCond (Q=1180 cfs) Run1



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55800

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 330.9 |
| 2 | 12.6 | 331.3 |
| 3 | 65.8 | 331.4 |
| 4 | 67.9 | 332.1 |
| 5 | 96 | 332.2 |
| 6 | 100.2 | 323.4 |
| 7 | 105.1 | 323.4 |
| 8 | 112.8 | 323.4 |
| 9 | 132.9 | 332.6 |
| 10 | 137.9 | 333 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 94 | 94 | 94 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

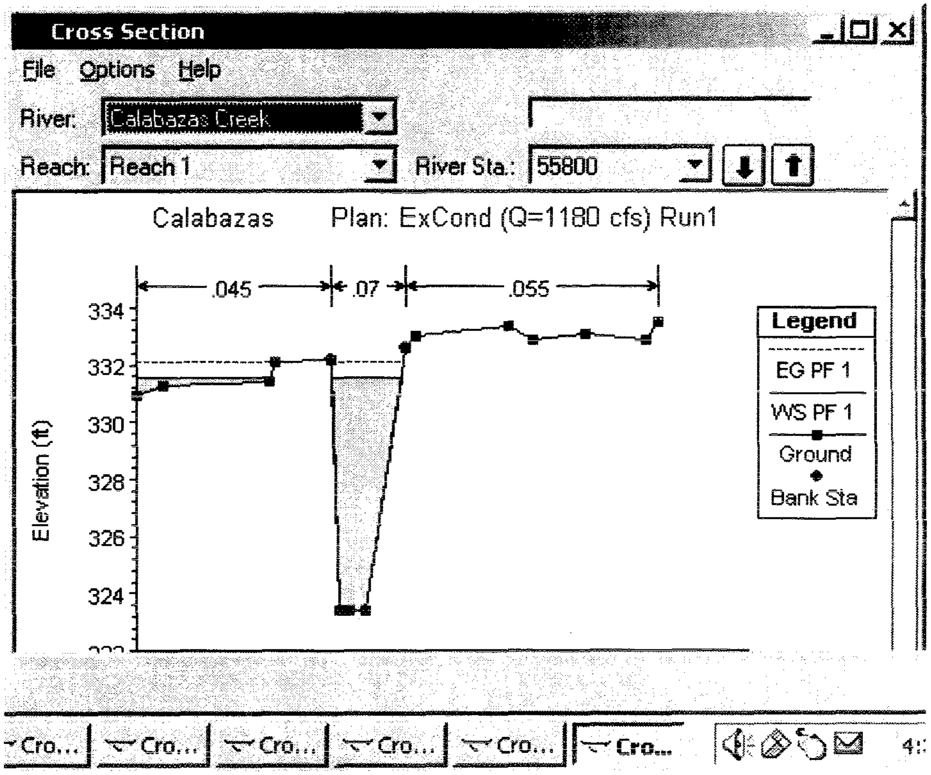
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 96 | 132.9 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

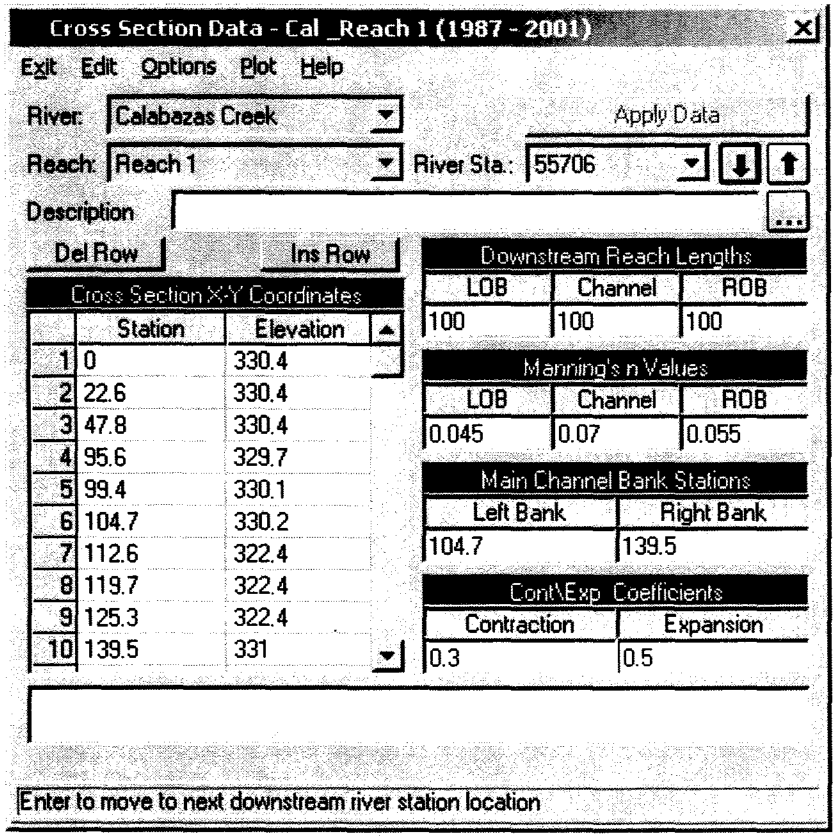
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55800



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55706

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 330.4 |
| 2 | 22.6 | 330.4 |
| 3 | 47.8 | 330.4 |
| 4 | 95.6 | 329.7 |
| 5 | 99.4 | 330.1 |
| 6 | 104.7 | 330.2 |
| 7 | 112.6 | 322.4 |
| 8 | 119.7 | 322.4 |
| 9 | 125.3 | 322.4 |
| 10 | 139.5 | 331 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

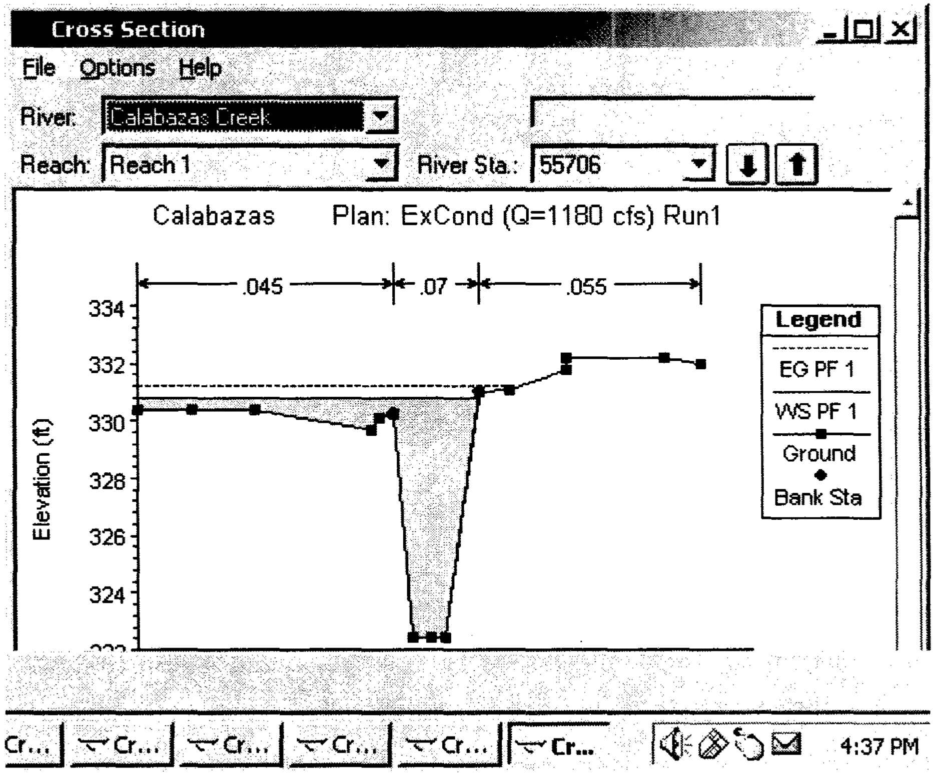
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 104.7 | 139.5 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

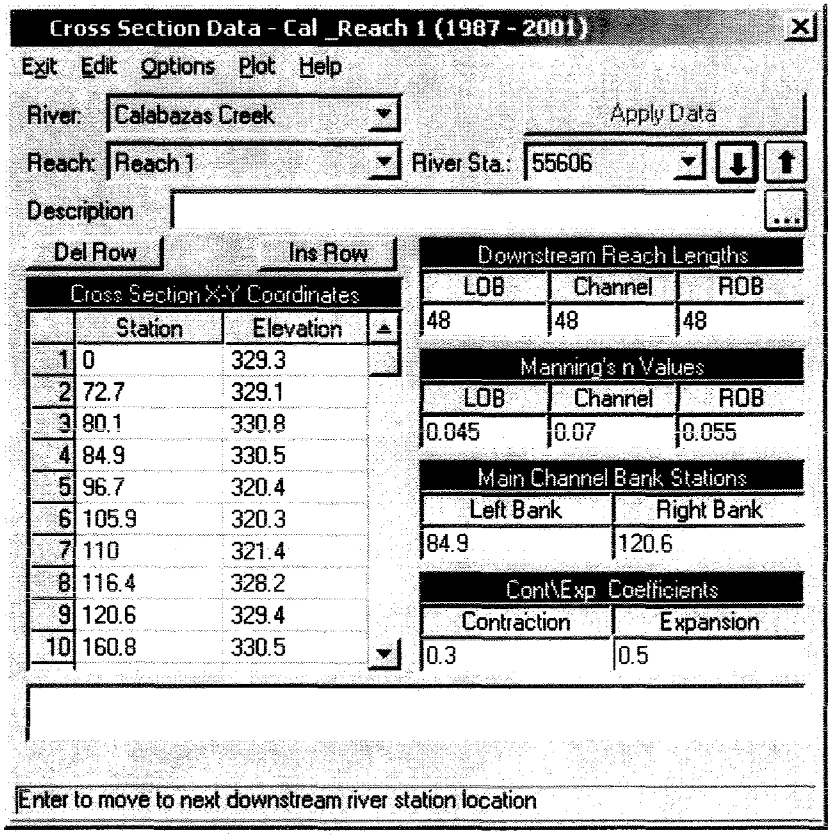
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55706



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55606

Description:

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 329.3 |
| 2 | 72.7 | 329.1 |
| 3 | 80.1 | 330.8 |
| 4 | 84.9 | 330.5 |
| 5 | 96.7 | 320.4 |
| 6 | 105.9 | 320.3 |
| 7 | 110 | 321.4 |
| 8 | 116.4 | 328.2 |
| 9 | 120.6 | 329.4 |
| 10 | 160.8 | 330.5 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 48 | 48 | 48 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

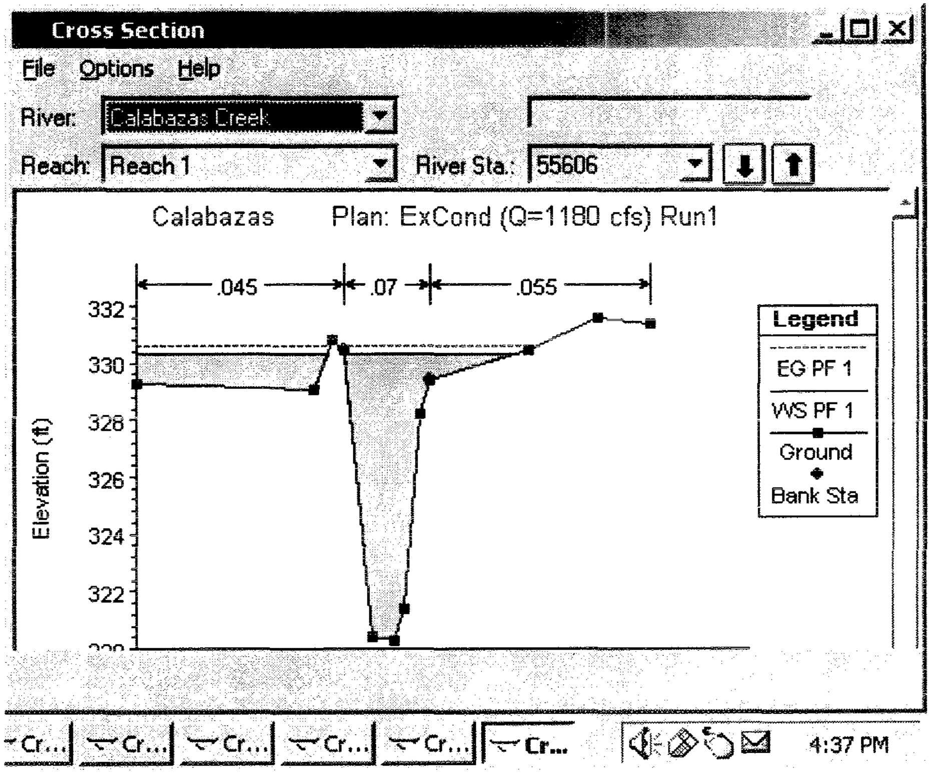
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 84.9 | 120.6 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

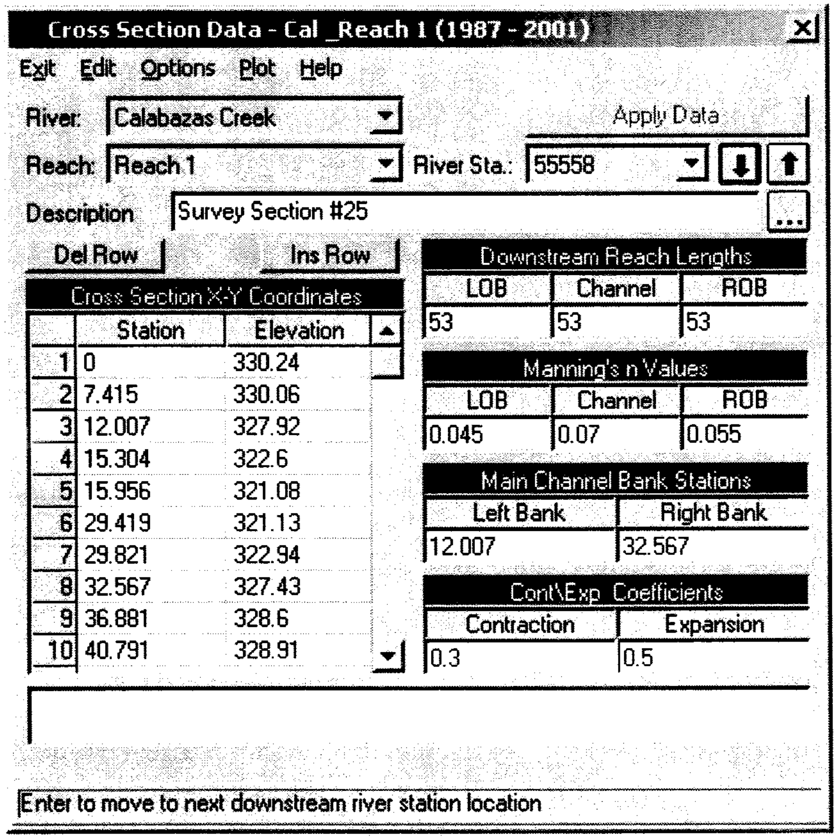
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55606



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55558

Description: Survey Section #25

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 330.24 |
| 2 | 7.415 | 330.06 |
| 3 | 12.007 | 327.92 |
| 4 | 15.304 | 322.6 |
| 5 | 15.956 | 321.08 |
| 6 | 29.419 | 321.13 |
| 7 | 29.821 | 322.94 |
| 8 | 32.567 | 327.43 |
| 9 | 36.881 | 328.6 |
| 10 | 40.791 | 328.91 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 53 | 53 | 53 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

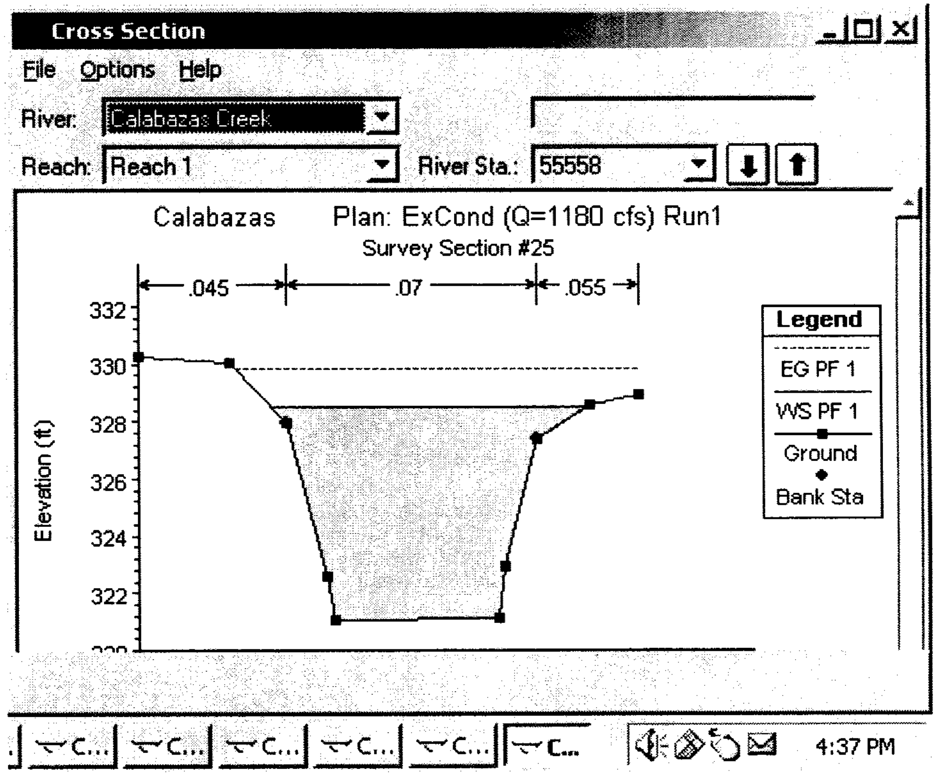
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 12.007 | 32.567 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

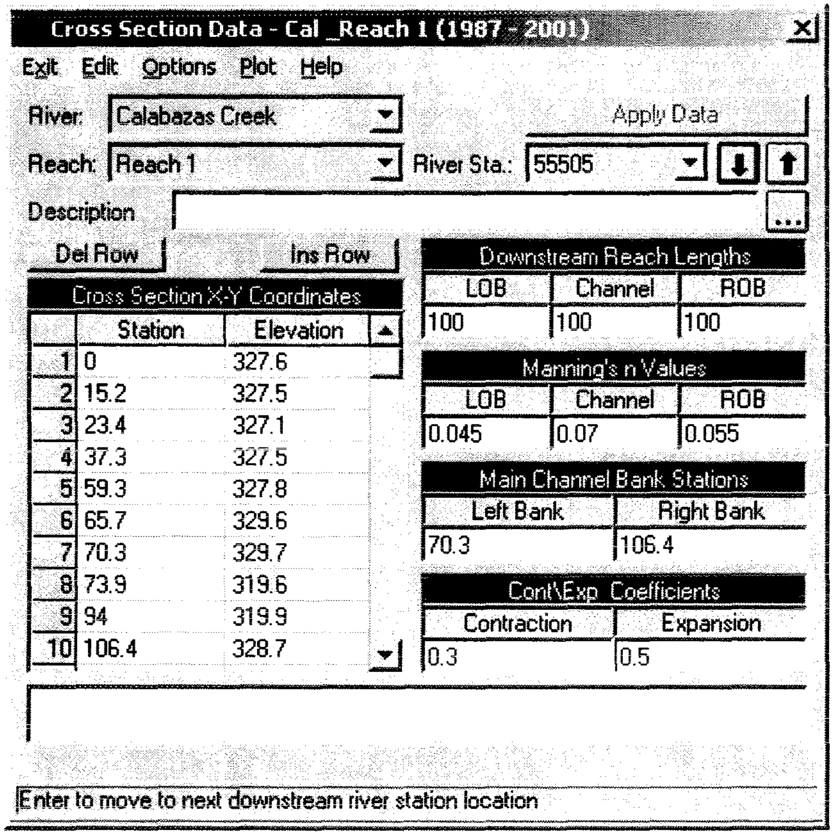


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55558



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55505

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 327.6 |
| 2 | 15.2 | 327.5 |
| 3 | 23.4 | 327.1 |
| 4 | 37.3 | 327.5 |
| 5 | 59.3 | 327.8 |
| 6 | 65.7 | 329.6 |
| 7 | 70.3 | 329.7 |
| 8 | 73.9 | 319.6 |
| 9 | 94 | 319.9 |
| 10 | 106.4 | 328.7 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

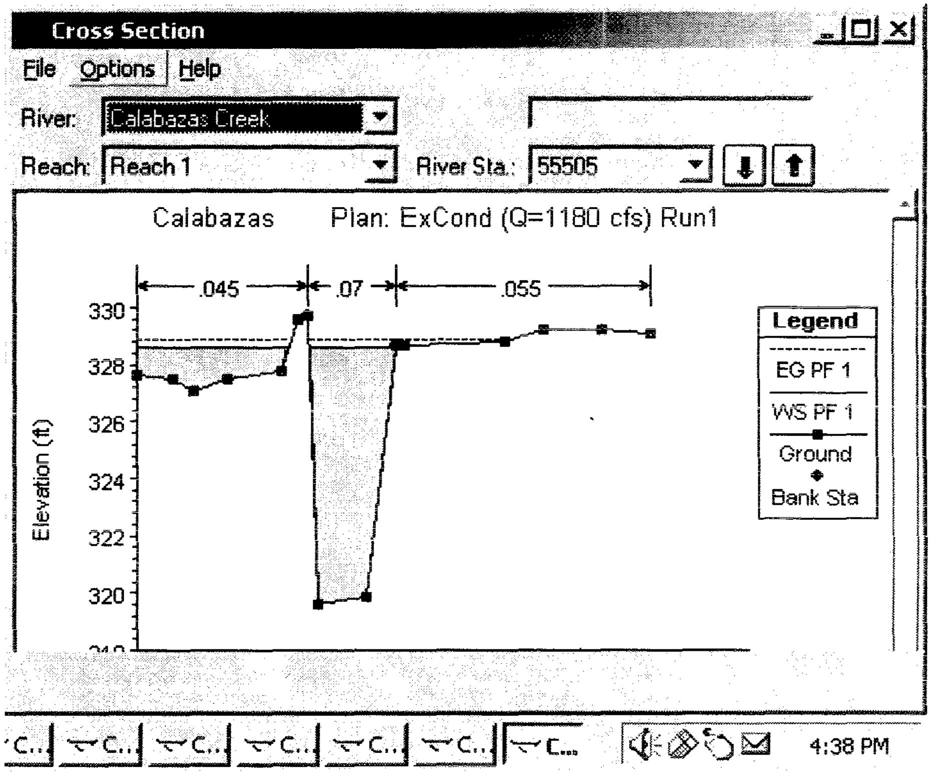
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 70.3 | 106.4 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

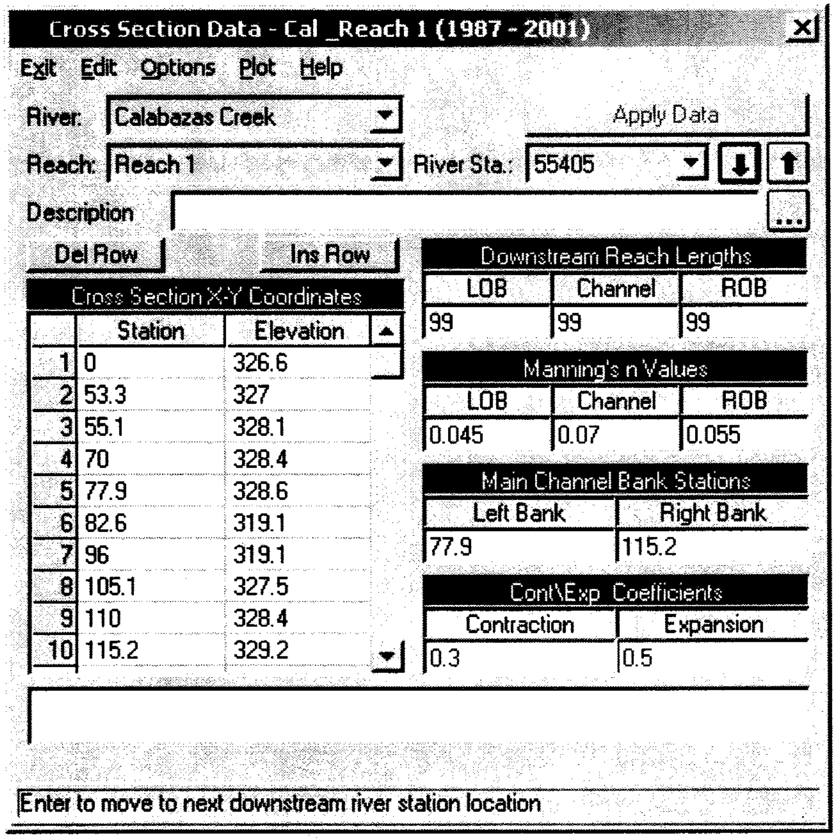
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55505



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55405

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 326.6 |
| 2 | 53.3 | 327 |
| 3 | 55.1 | 328.1 |
| 4 | 70 | 328.4 |
| 5 | 77.9 | 328.6 |
| 6 | 82.6 | 319.1 |
| 7 | 96 | 319.1 |
| 8 | 105.1 | 327.5 |
| 9 | 110 | 328.4 |
| 10 | 115.2 | 329.2 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 99 | 99 | 99 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

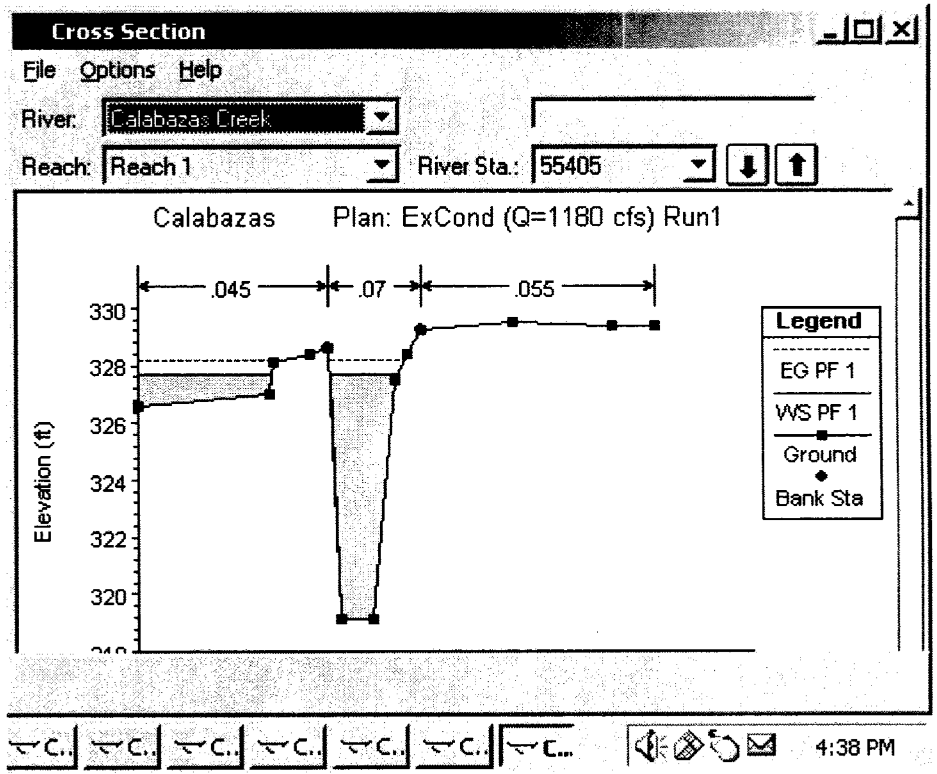
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 77.9 | 115.2 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

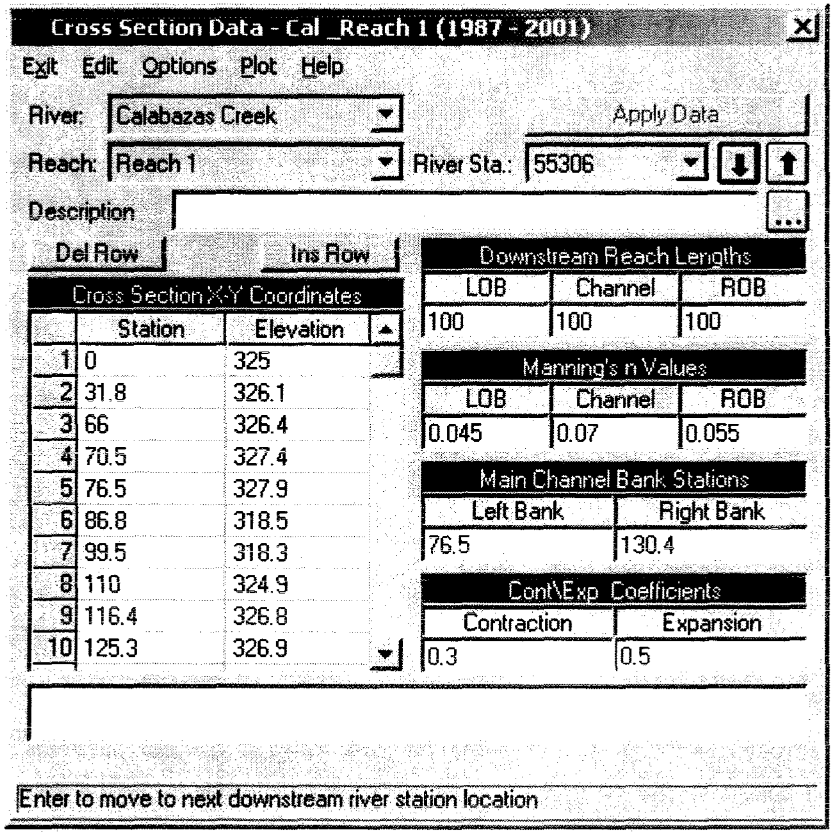


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 55405



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55306

Description

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 325 |
| 2 | 31.8 | 326.1 |
| 3 | 66 | 326.4 |
| 4 | 70.5 | 327.4 |
| 5 | 76.5 | 327.9 |
| 6 | 86.8 | 318.5 |
| 7 | 99.5 | 318.3 |
| 8 | 110 | 324.9 |
| 9 | 116.4 | 326.8 |
| 10 | 125.3 | 326.9 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

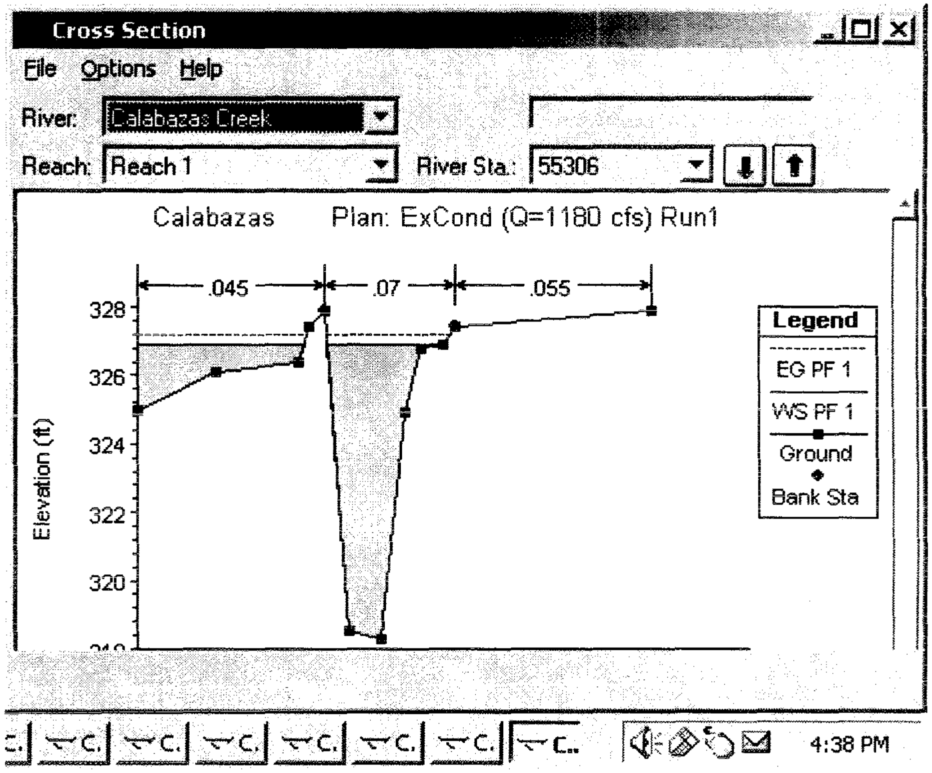
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 76.5 | 130.4 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

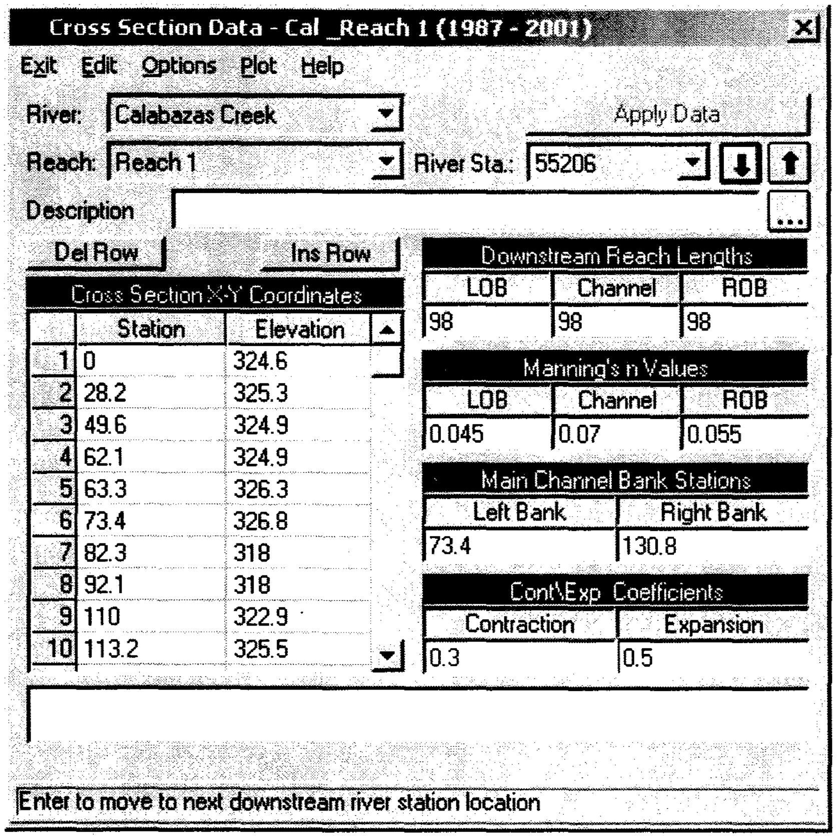
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55306



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55206

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 324.6 |
| 2 | 28.2 | 325.3 |
| 3 | 49.6 | 324.9 |
| 4 | 62.1 | 324.9 |
| 5 | 63.3 | 326.3 |
| 6 | 73.4 | 326.8 |
| 7 | 82.3 | 318 |
| 8 | 92.1 | 318 |
| 9 | 110 | 322.9 |
| 10 | 113.2 | 325.5 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 98 | 98 | 98 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

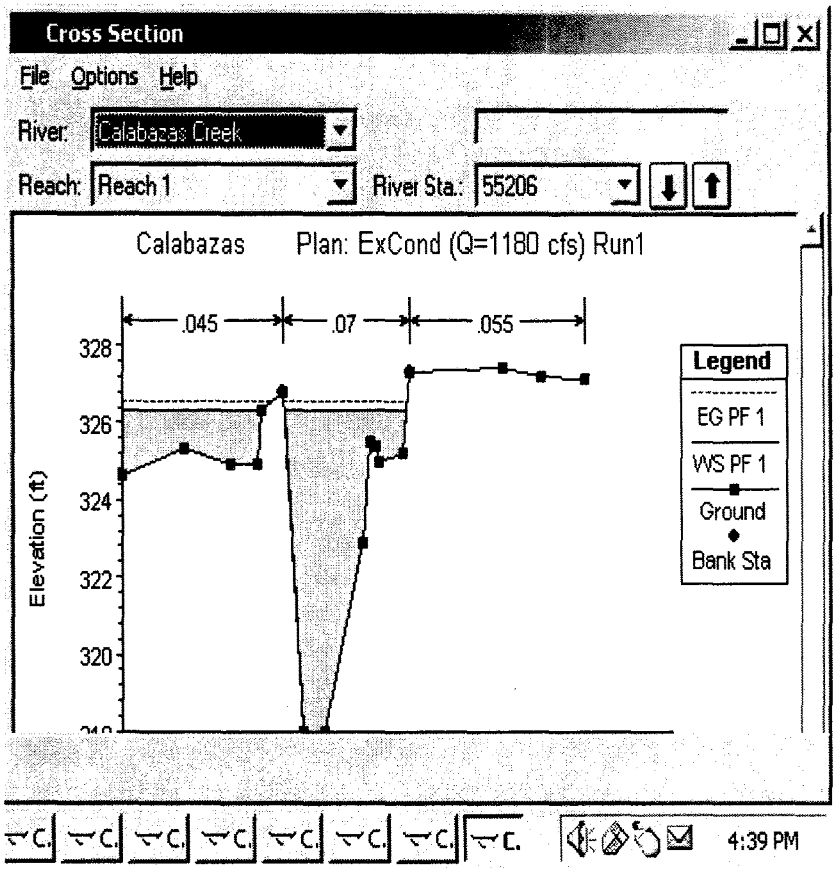
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 73.4 | 130.8 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

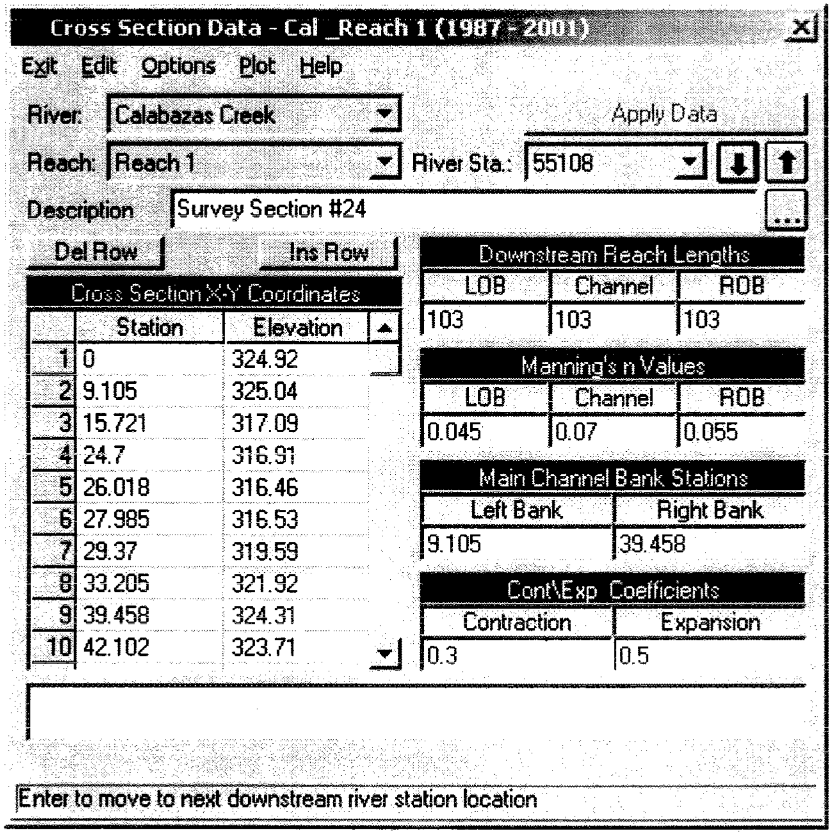
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55206



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55108

Description: Survey Section #24

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 324.92 |
| 2 | 9.105 | 325.04 |
| 3 | 15.721 | 317.09 |
| 4 | 24.7 | 316.91 |
| 5 | 26.018 | 316.46 |
| 6 | 27.985 | 316.53 |
| 7 | 29.37 | 319.59 |
| 8 | 33.205 | 321.92 |
| 9 | 39.458 | 324.31 |
| 10 | 42.102 | 323.71 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 103 | 103 | 103 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

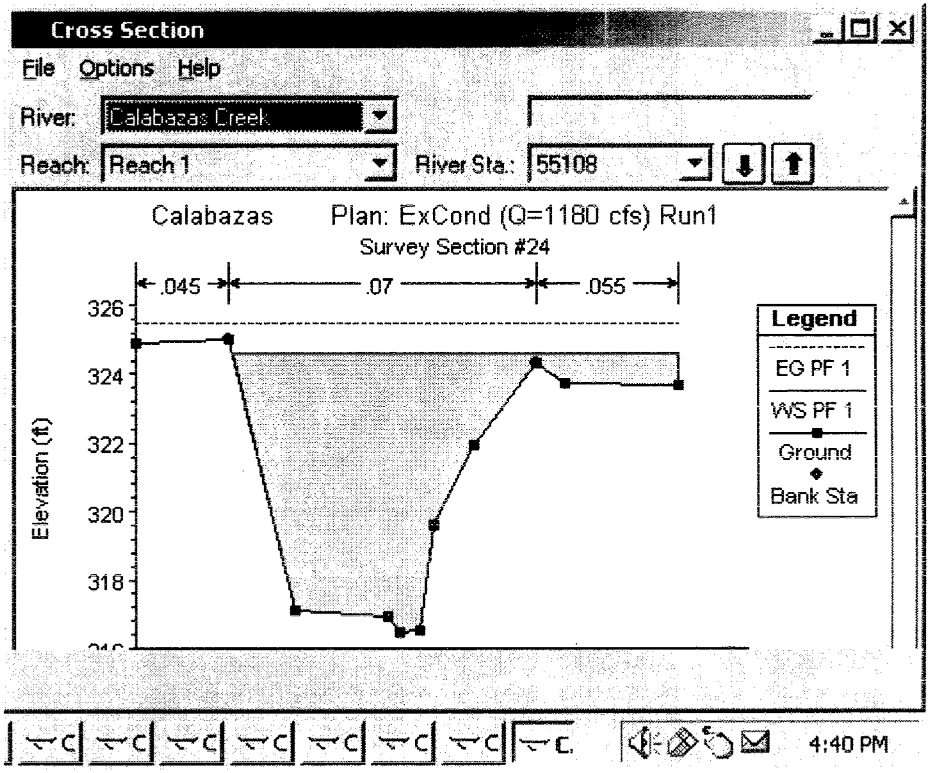
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 9.105 | 39.458 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

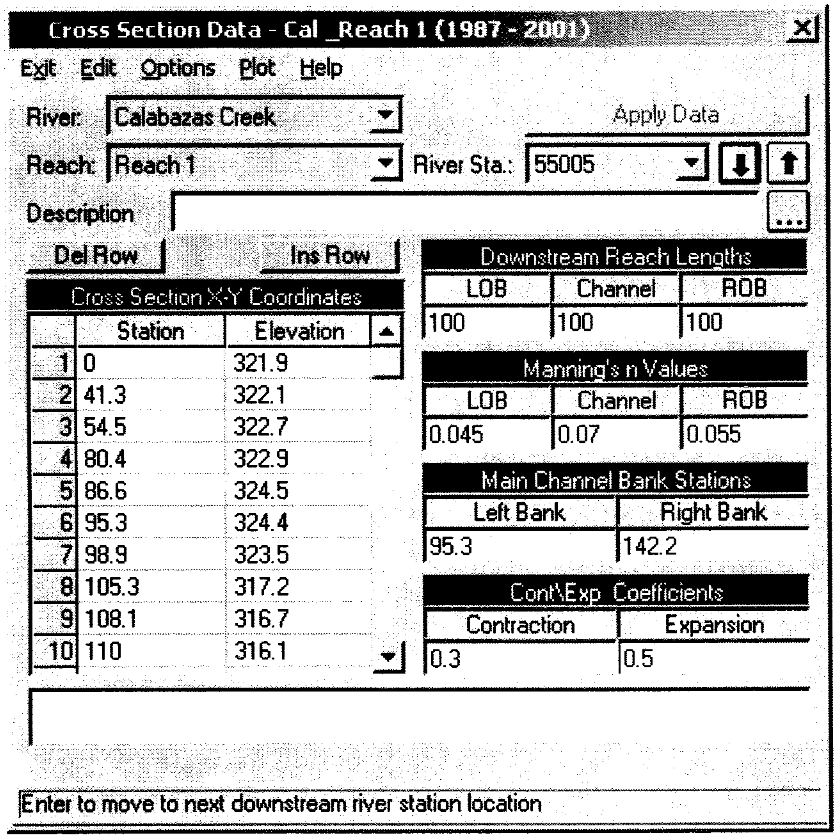
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55108



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55005

Description

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 321.9 |
| 2 | 41.3 | 322.1 |
| 3 | 54.5 | 322.7 |
| 4 | 80.4 | 322.9 |
| 5 | 86.6 | 324.5 |
| 6 | 95.3 | 324.4 |
| 7 | 98.9 | 323.5 |
| 8 | 105.3 | 317.2 |
| 9 | 108.1 | 316.7 |
| 10 | 110 | 316.1 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

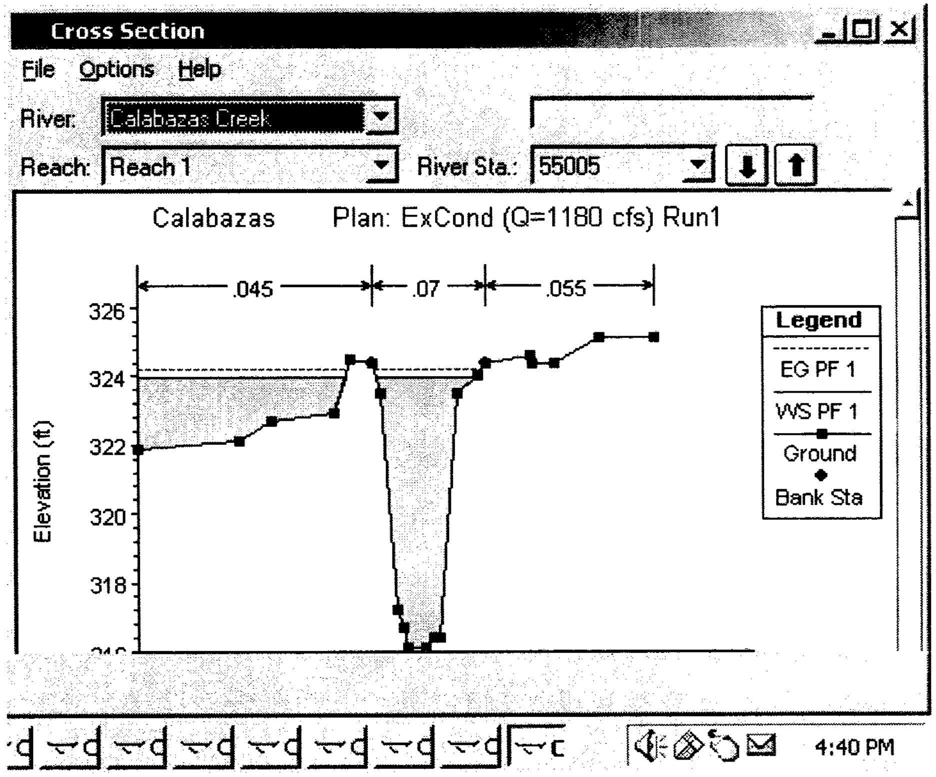
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 95.3 | 142.2 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

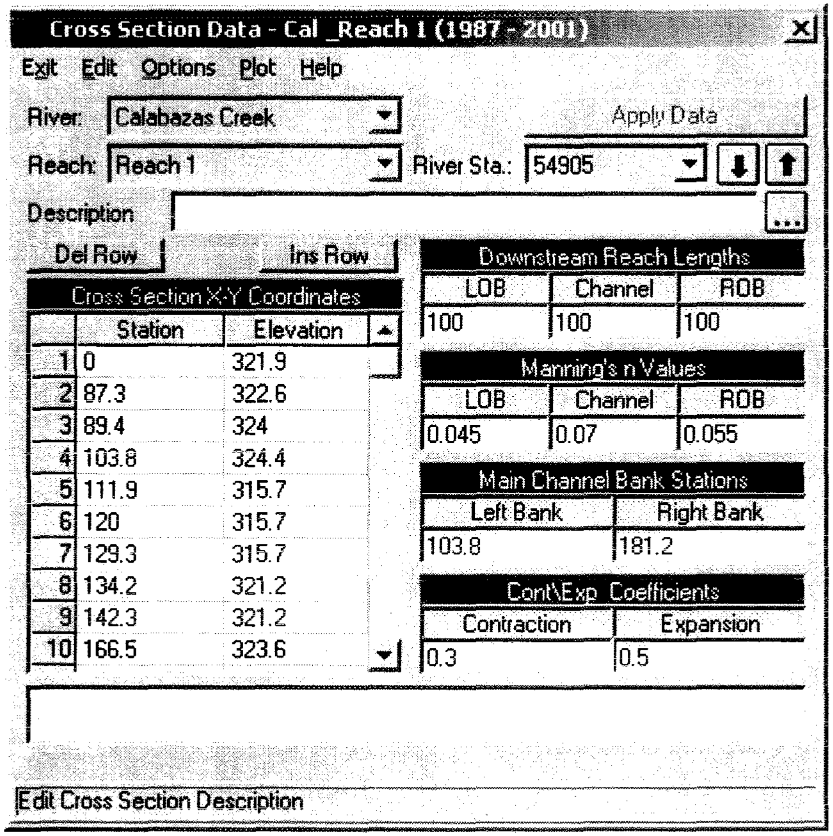
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 55005



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54905

Description:

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 321.9 |
| 2 | 87.3 | 322.6 |
| 3 | 89.4 | 324 |
| 4 | 103.8 | 324.4 |
| 5 | 111.9 | 315.7 |
| 6 | 120 | 315.7 |
| 7 | 129.3 | 315.7 |
| 8 | 134.2 | 321.2 |
| 9 | 142.3 | 321.2 |
| 10 | 166.5 | 323.6 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

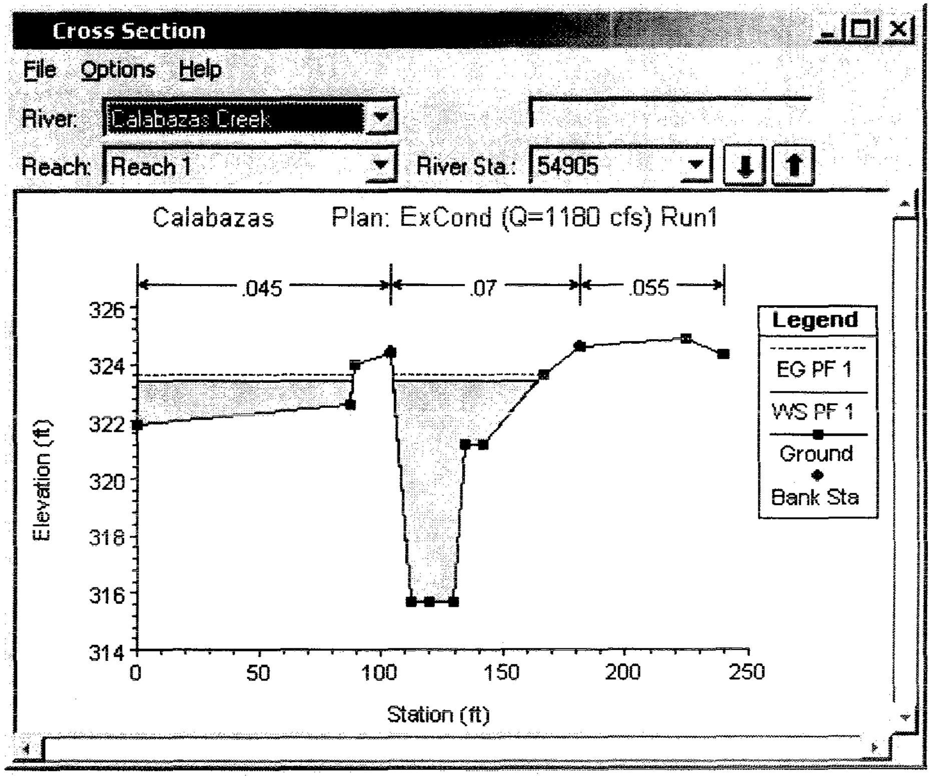
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 103.8 | 181.2 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

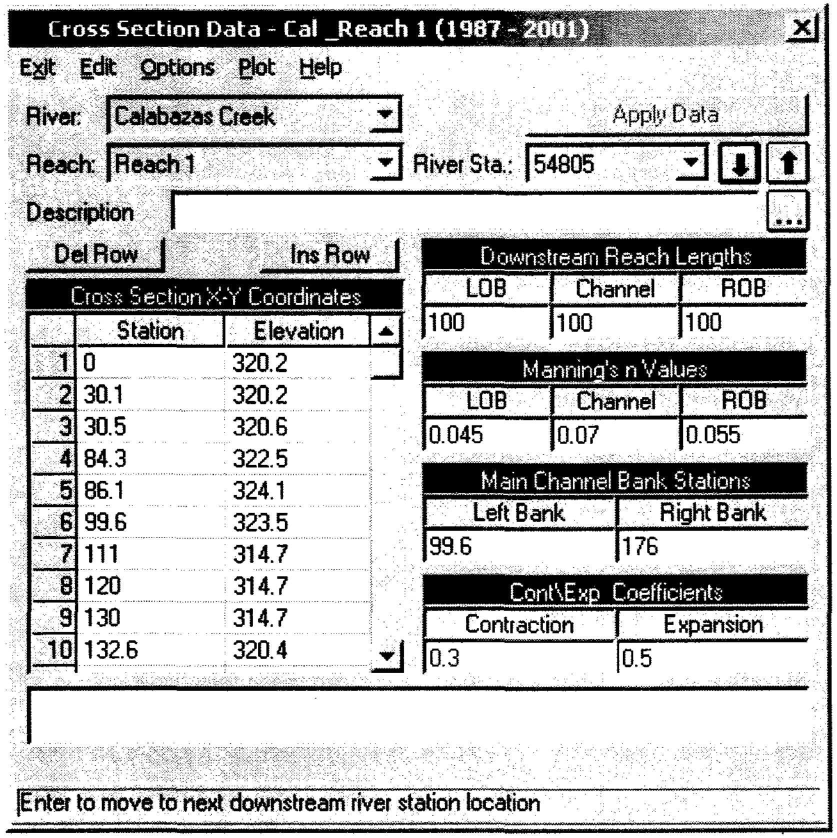
Edit Cross Section Description



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54905



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54805

Description

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 320.2 |
| 2 | 30.1 | 320.2 |
| 3 | 30.5 | 320.6 |
| 4 | 84.3 | 322.5 |
| 5 | 86.1 | 324.1 |
| 6 | 99.6 | 323.5 |
| 7 | 111 | 314.7 |
| 8 | 120 | 314.7 |
| 9 | 130 | 314.7 |
| 10 | 132.6 | 320.4 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 100 | 100 | 100 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

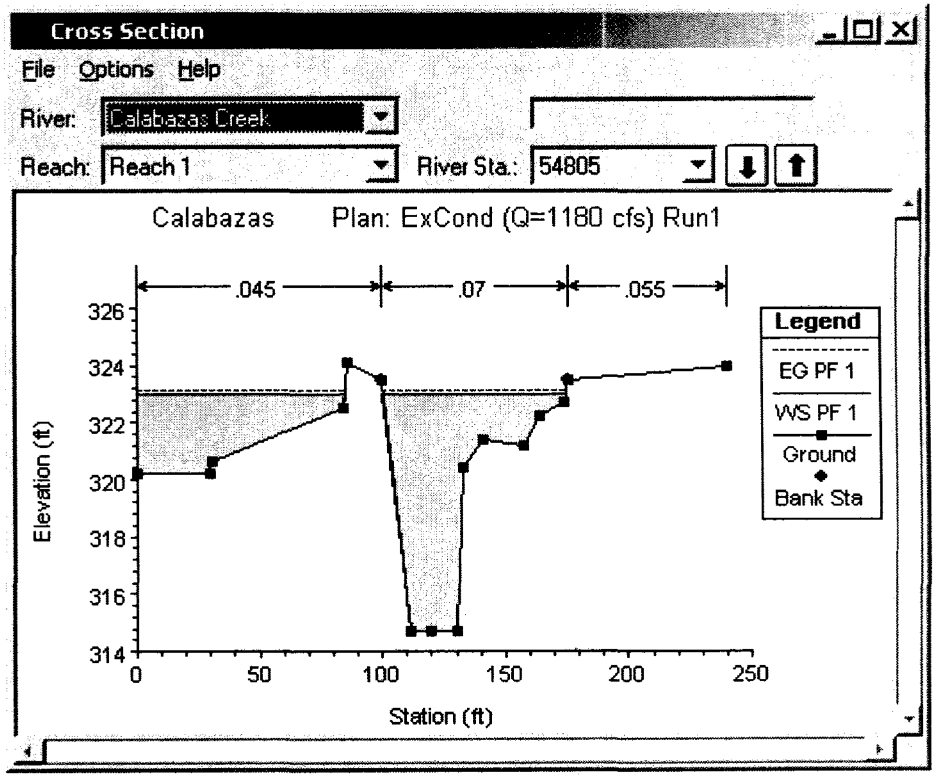
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 99.6 | 176 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

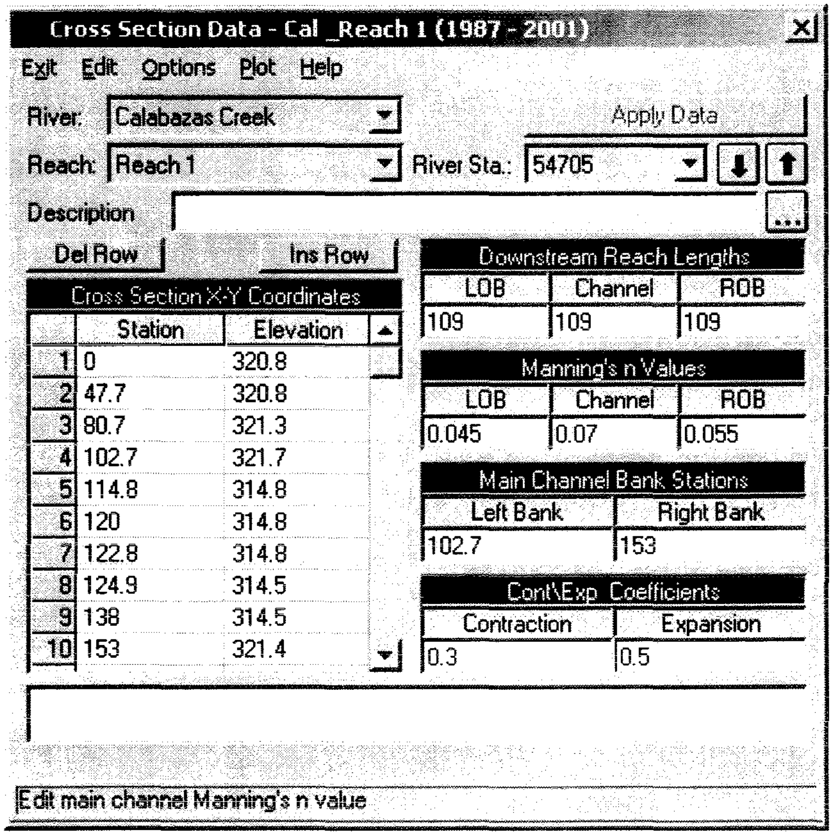
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54805



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54705

Description

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 320.8 |
| 2 | 47.7 | 320.8 |
| 3 | 80.7 | 321.3 |
| 4 | 102.7 | 321.7 |
| 5 | 114.8 | 314.8 |
| 6 | 120 | 314.8 |
| 7 | 122.8 | 314.8 |
| 8 | 124.9 | 314.5 |
| 9 | 138 | 314.5 |
| 10 | 153 | 321.4 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 109 | 109 | 109 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

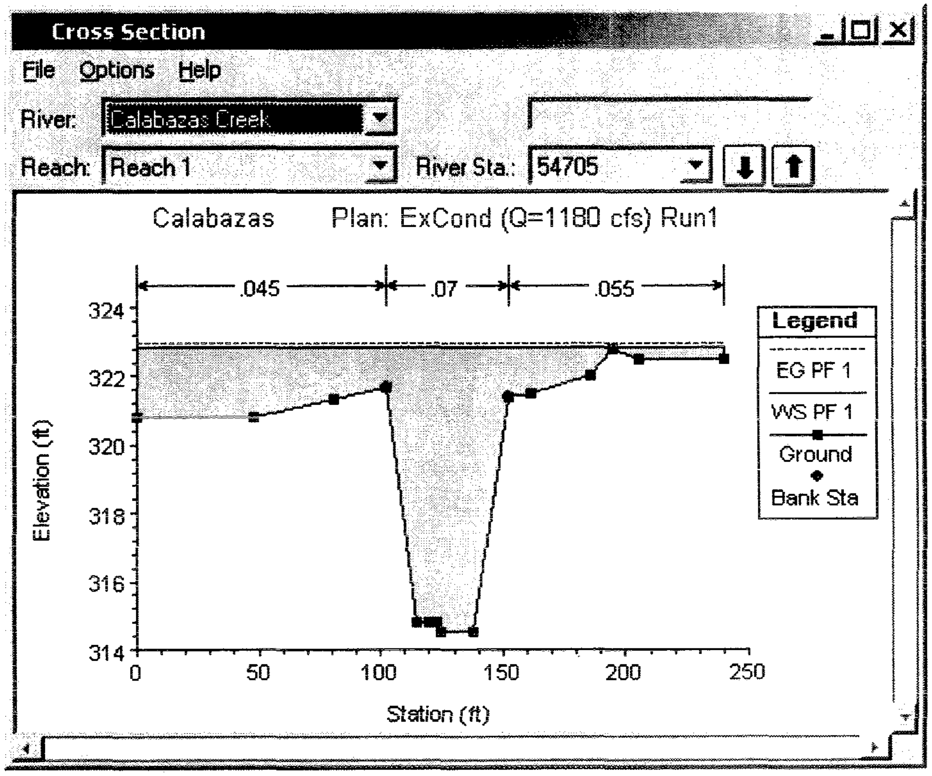
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 102.7 | 153 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Edit main channel Manning's n value



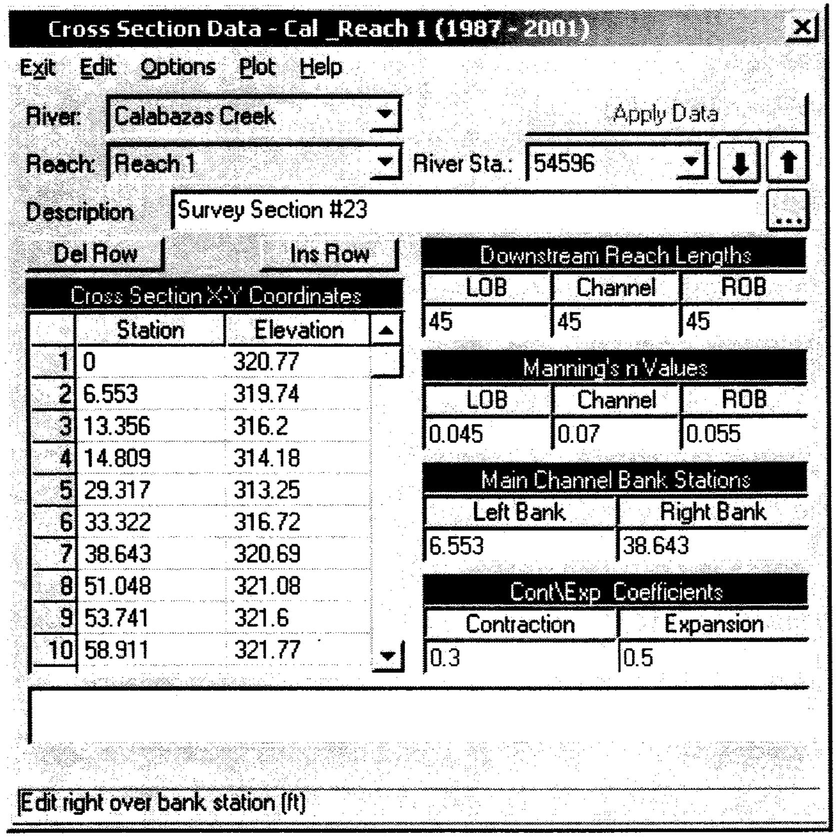
**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54705

Calabazas Plan: ExCond (Q=1180 cfs) Run1



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54596

Description: Survey Section #23

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 320.77 |
| 2 | 6.553 | 319.74 |
| 3 | 13.356 | 316.2 |
| 4 | 14.809 | 314.18 |
| 5 | 29.317 | 313.25 |
| 6 | 33.322 | 316.72 |
| 7 | 38.643 | 320.69 |
| 8 | 51.048 | 321.08 |
| 9 | 53.741 | 321.6 |
| 10 | 58.911 | 321.77 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 45 | 45 | 45 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

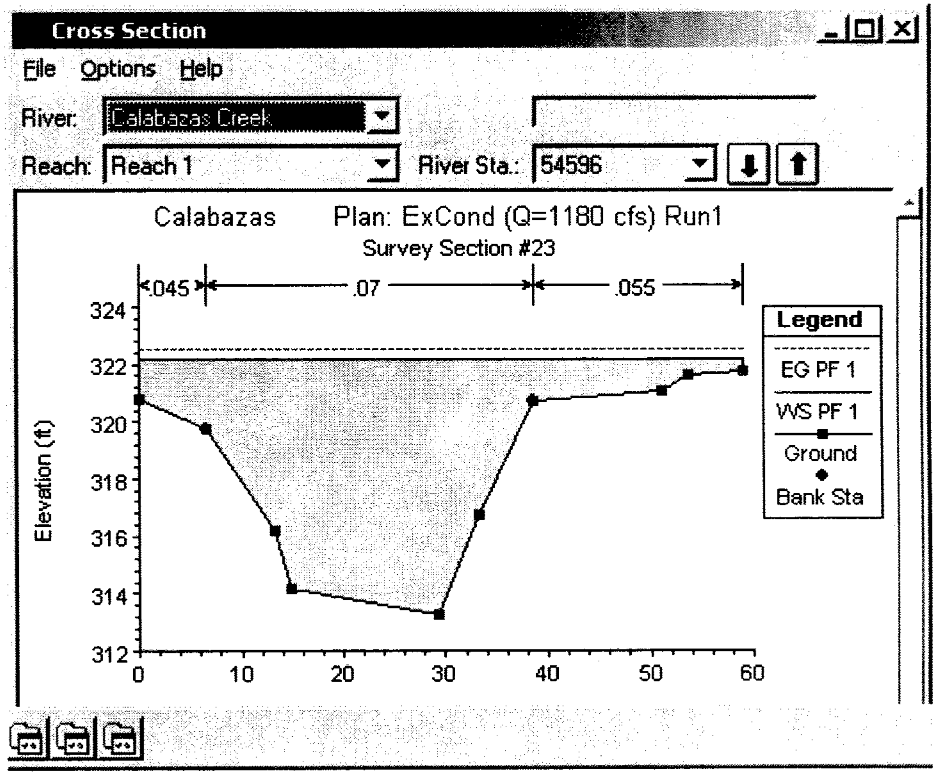
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 6.553 | 38.643 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

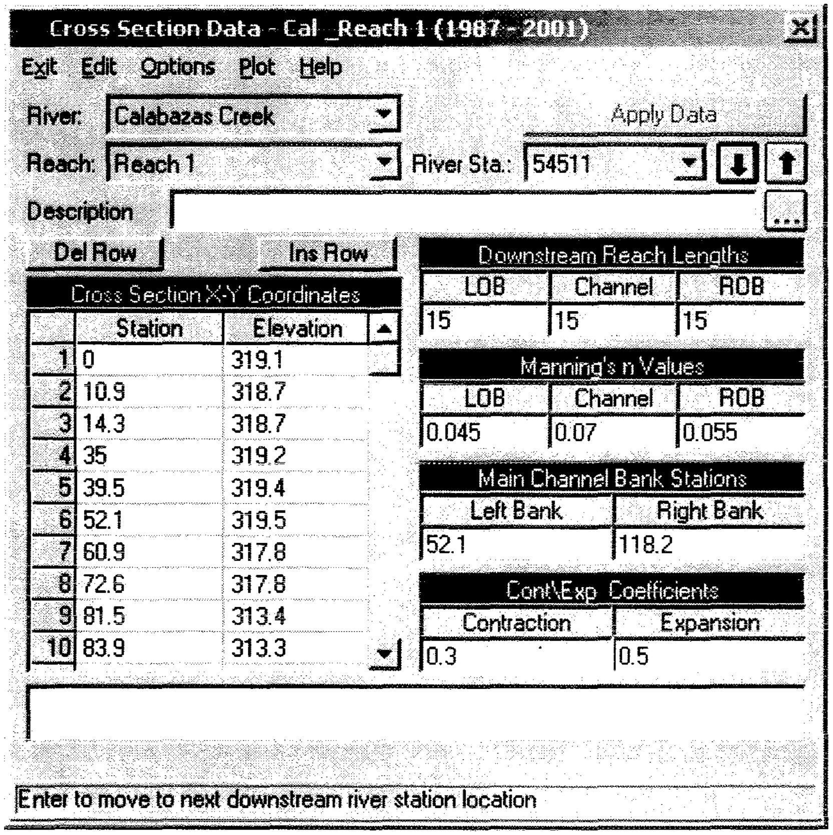
Edit right over bank station (ft)



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54596


Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1 River Sta.: 54511

Description:

Cross Section X-Y Coordinates

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 319.1 |
| 2 | 10.9 | 318.7 |
| 3 | 14.3 | 318.7 |
| 4 | 35 | 319.2 |
| 5 | 39.5 | 319.4 |
| 6 | 52.1 | 319.5 |
| 7 | 60.9 | 317.8 |
| 8 | 72.6 | 317.8 |
| 9 | 81.5 | 313.4 |
| 10 | 83.9 | 313.3 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 15 | 15 | 15 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

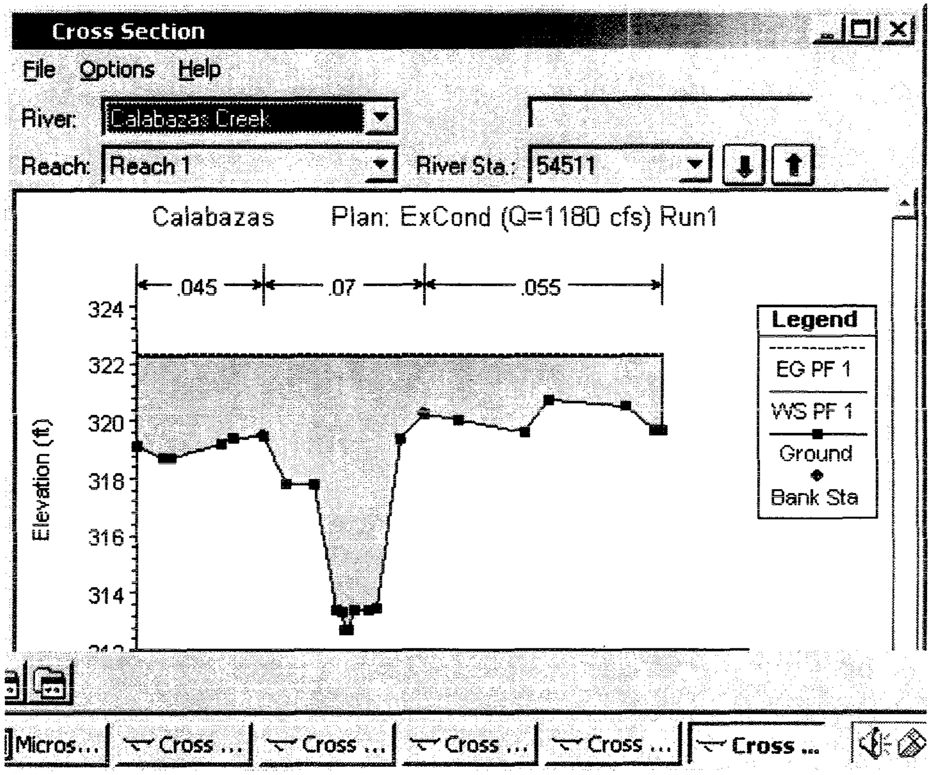
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 52.1 | 118.2 |

Cont\Exp Coefficients

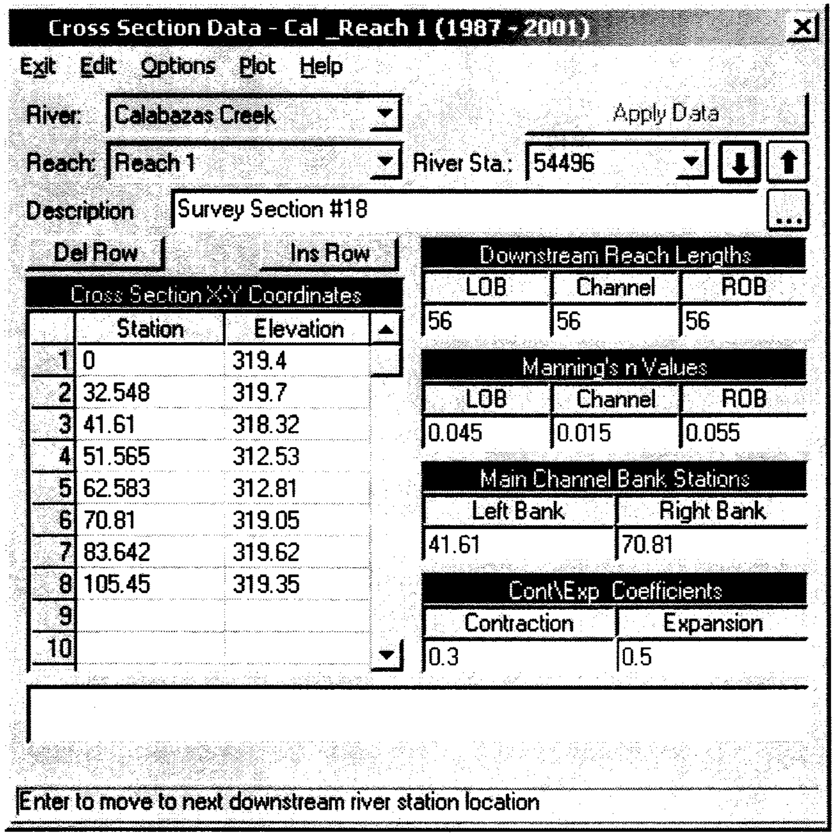
| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1 River Sta.: 54511



Cross Section Data - Cal _Reach 1 (1987 - 2001)

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54496

Description: Survey Section #18

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 319.4 |
| 2 | 32.548 | 319.7 |
| 3 | 41.61 | 318.32 |
| 4 | 51.565 | 312.53 |
| 5 | 62.583 | 312.81 |
| 6 | 70.81 | 319.05 |
| 7 | 83.642 | 319.62 |
| 8 | 105.45 | 319.35 |
| 9 | | |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 56 | 56 | 56 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.015 | 0.055 |

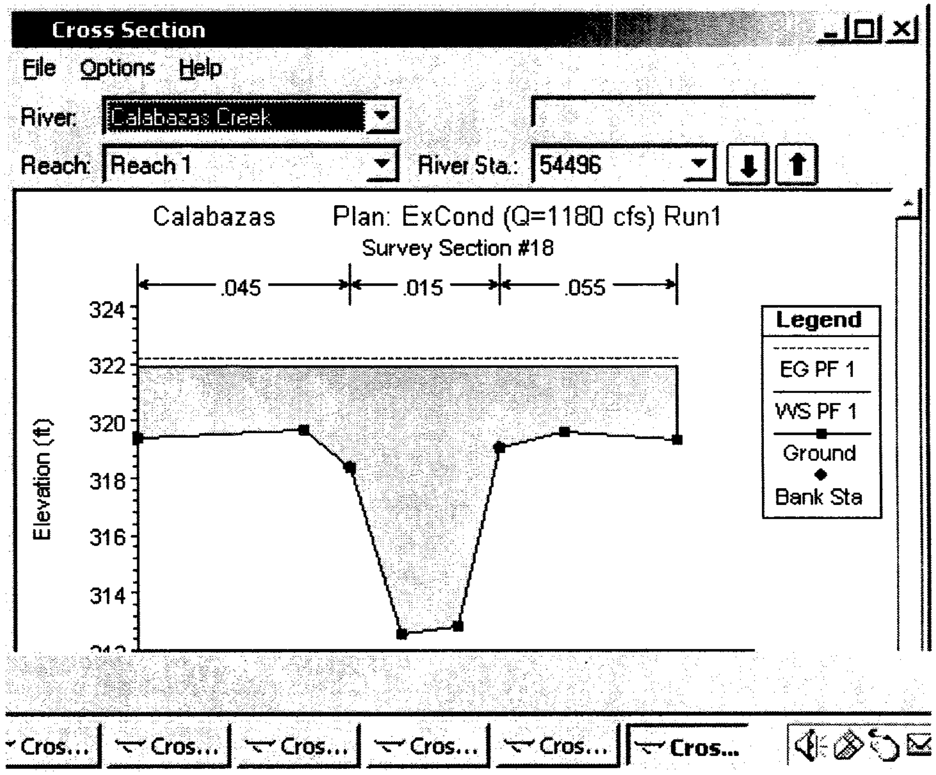
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 41.61 | 70.81 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

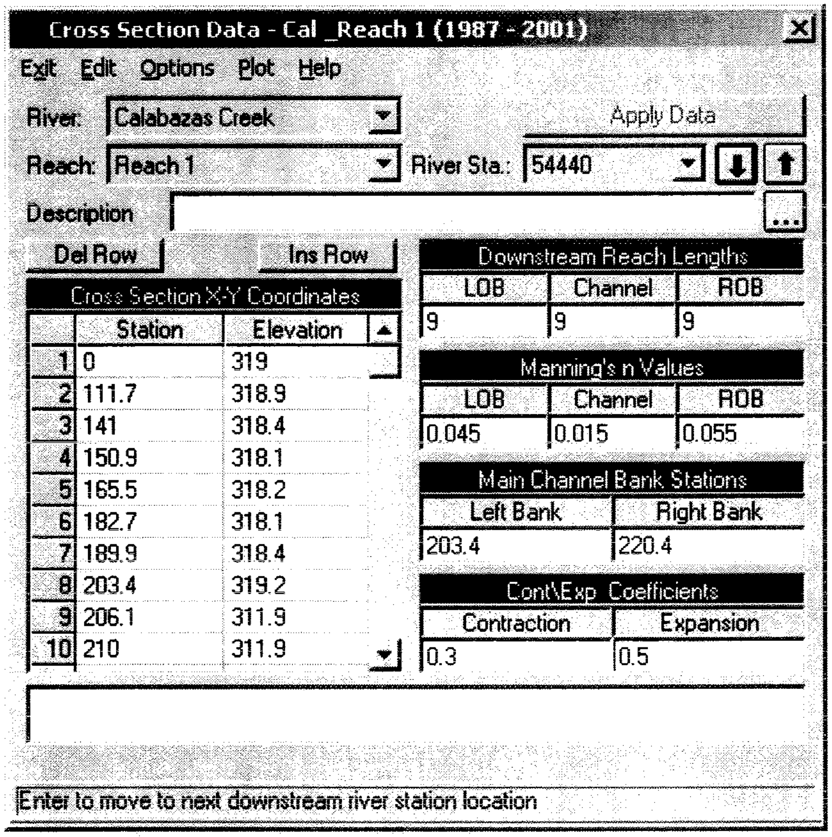


Cross Section

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54496



**Cross Section Data - Cal _Reach 1 (1987 - 2001)**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54440

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 319 |
| 2 | 111.7 | 318.9 |
| 3 | 141 | 318.4 |
| 4 | 150.9 | 318.1 |
| 5 | 165.5 | 318.2 |
| 6 | 182.7 | 318.1 |
| 7 | 189.9 | 318.4 |
| 8 | 203.4 | 319.2 |
| 9 | 206.1 | 311.9 |
| 10 | 210 | 311.9 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 9 | 9 | 9 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.015 | 0.055 |

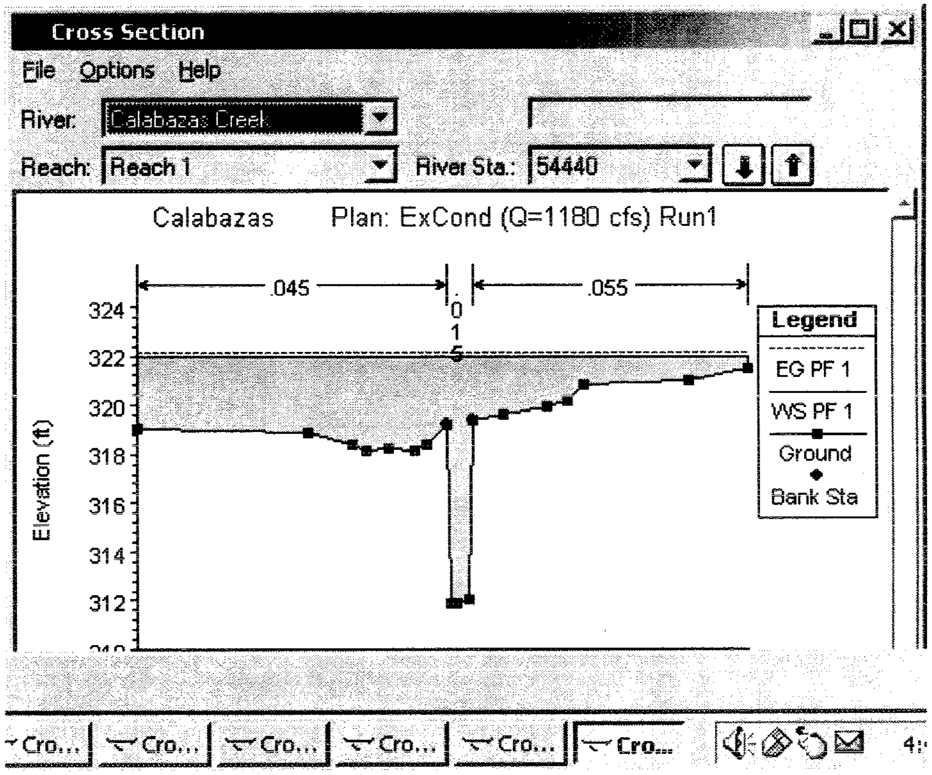
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 203.4 | 220.4 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next downstream river station location

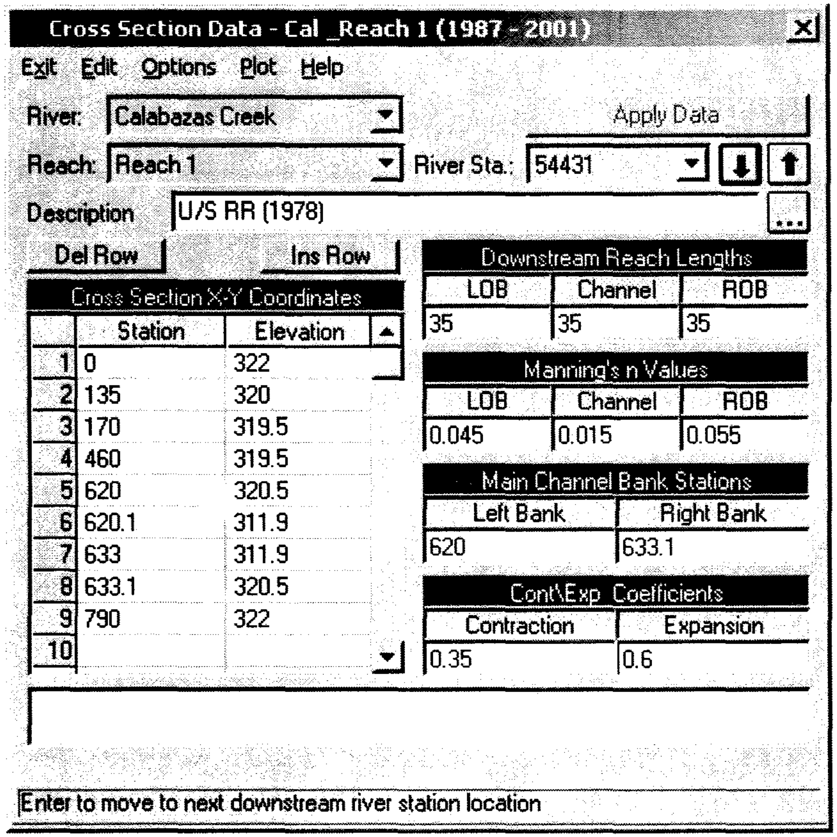


**Cross Section**

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54440



Cross Section Data - Cal _Reach 1 (1987 - 2001)
Exit Edit Options Plot Help
Apply Data
Del Row
Ins Row

River: Calabazas Creek

Reach: Reach 1

River Sta.: 54431

Description: U/S RR (1978)

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 322 |
| 2 | 135 | 320 |
| 3 | 170 | 319.5 |
| 4 | 460 | 319.5 |
| 5 | 620 | 320.5 |
| 6 | 620.1 | 311.9 |
| 7 | 633 | 311.9 |
| 8 | 633.1 | 320.5 |
| 9 | 790 | 322 |
| 10 | | |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 35 | 35 | 35 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.015 | 0.055 |

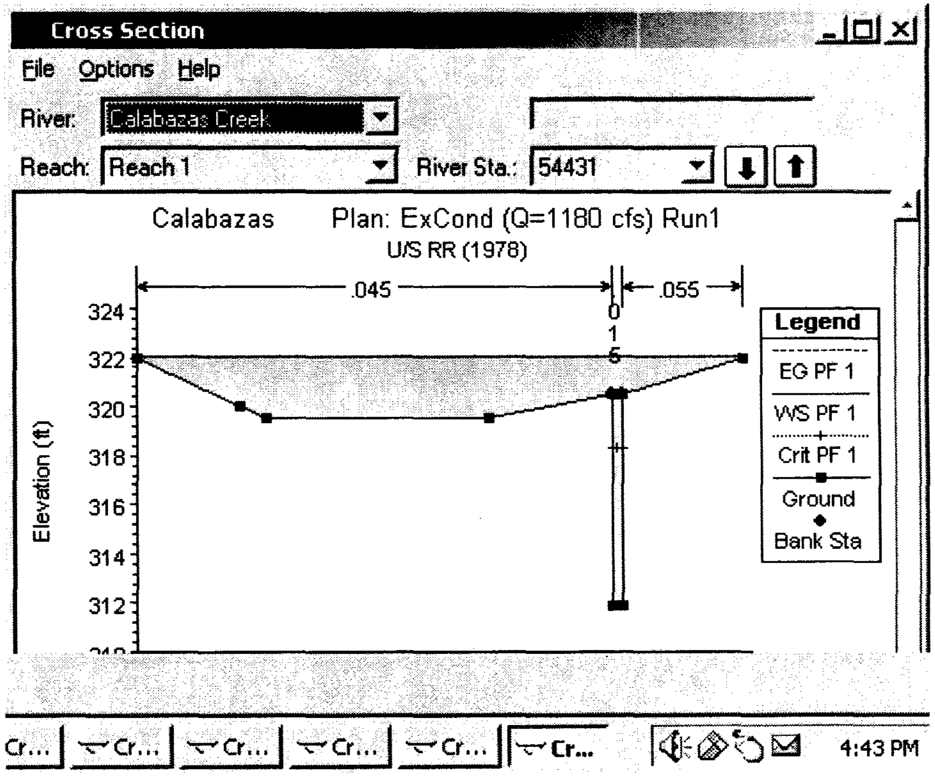
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 620 | 633.1 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.35 | 0.6 |

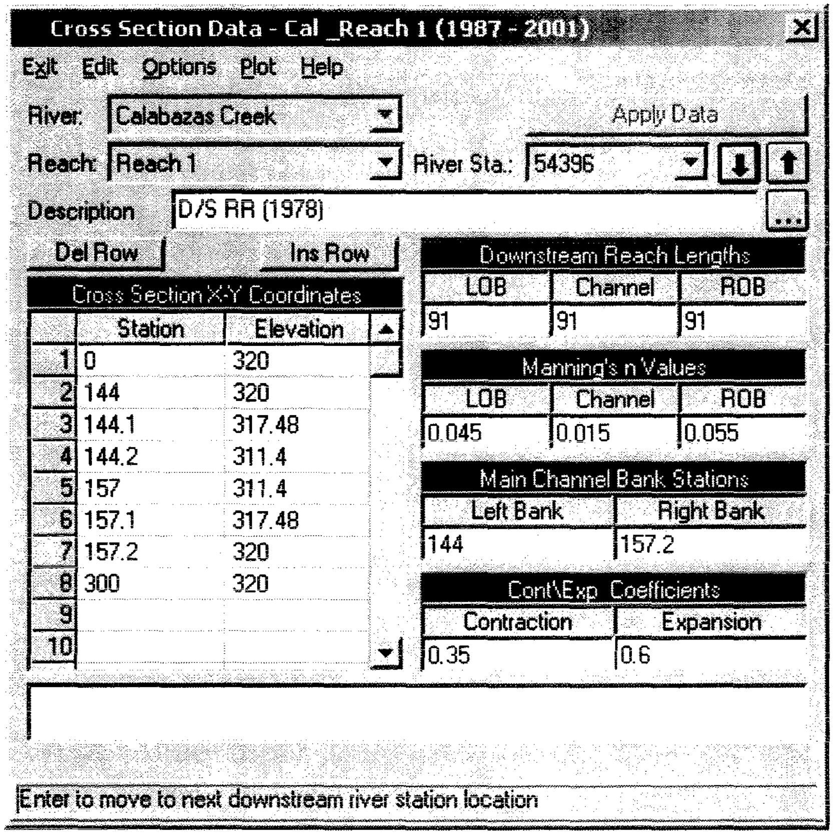
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54431



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54396

Description: D/S RR (1978)

**Cross Section X-Y Coordinates**

|  | Station | Elevation |
|---|---|---|
| 1 | 0 | 320 |
| 2 | 144 | 320 |
| 3 | 144.1 | 317.48 |
| 4 | 144.2 | 311.4 |
| 5 | 157 | 311.4 |
| 6 | 157.1 | 317.48 |
| 7 | 157.2 | 320 |
| 8 | 300 | 320 |
| 9 |  |  |
| 10 |  |  |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 91 | 91 | 91 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.015 | 0.055 |

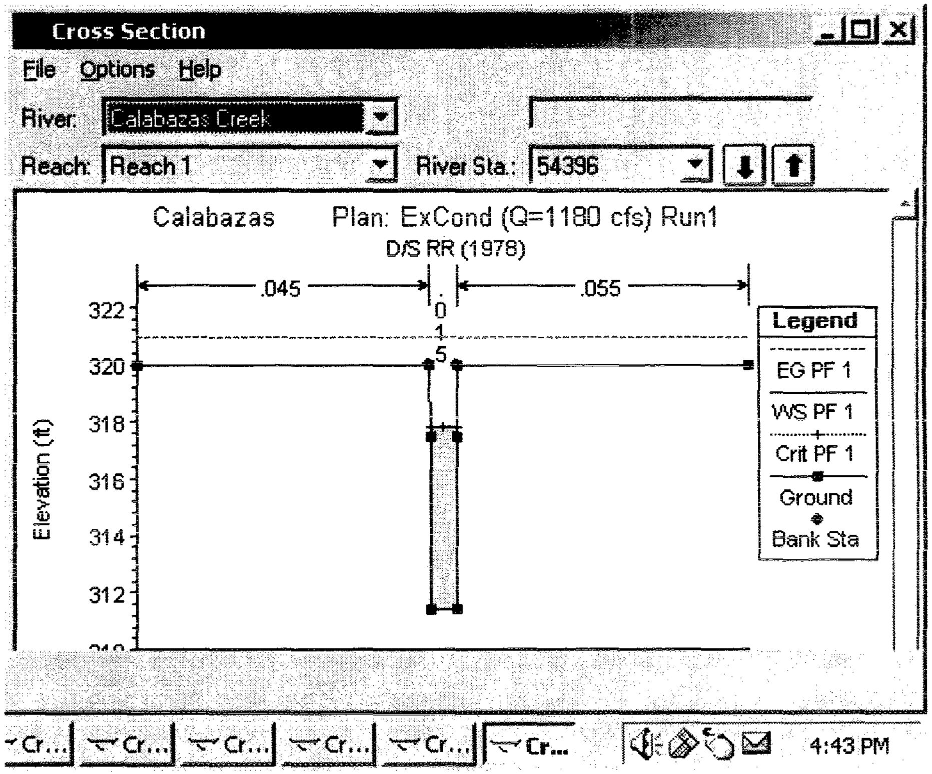
**Main Channel Bank Stations**

| Left Bank | Right Bank |
|---|---|
| 144 | 157.2 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.35 | 0.6 |

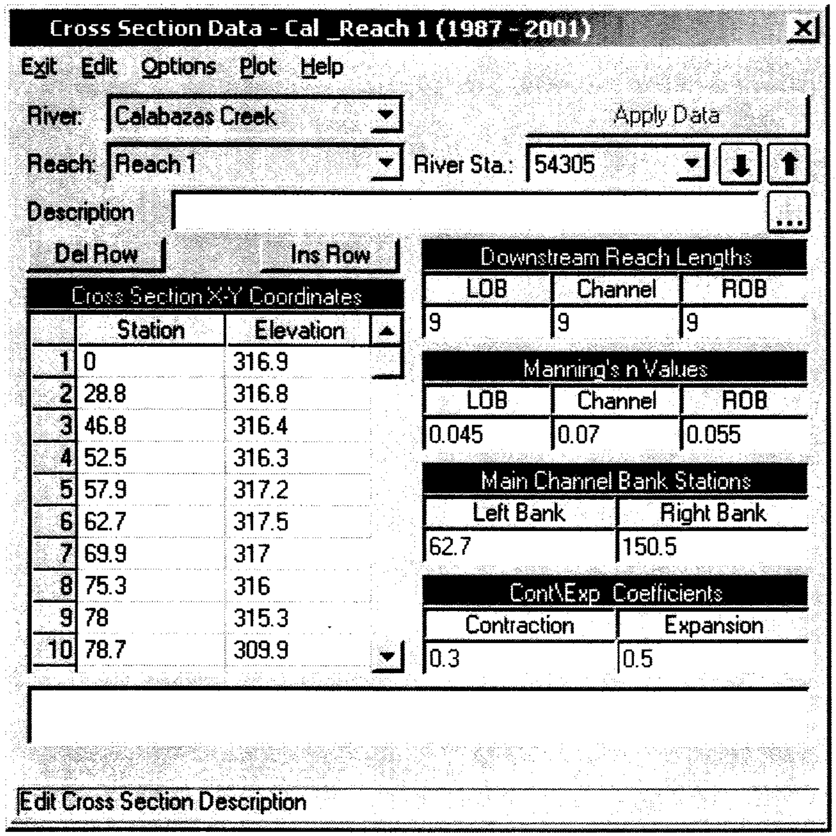
Enter to move to next downstream river station location



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54396



River: Calabazas Creek

Reach: Reach 1

River Sta.: 54305

Description:

**Cross Section X-Y Coordinates**

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 316.9 |
| 2 | 28.8 | 316.8 |
| 3 | 46.8 | 316.4 |
| 4 | 52.5 | 316.3 |
| 5 | 57.9 | 317.2 |
| 6 | 62.7 | 317.5 |
| 7 | 69.9 | 317 |
| 8 | 75.3 | 316 |
| 9 | 78 | 315.3 |
| 10 | 78.7 | 309.9 |

**Downstream Reach Lengths**

| LOB | Channel | ROB |
|---|---|---|
| 9 | 9 | 9 |

**Manning's n Values**

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

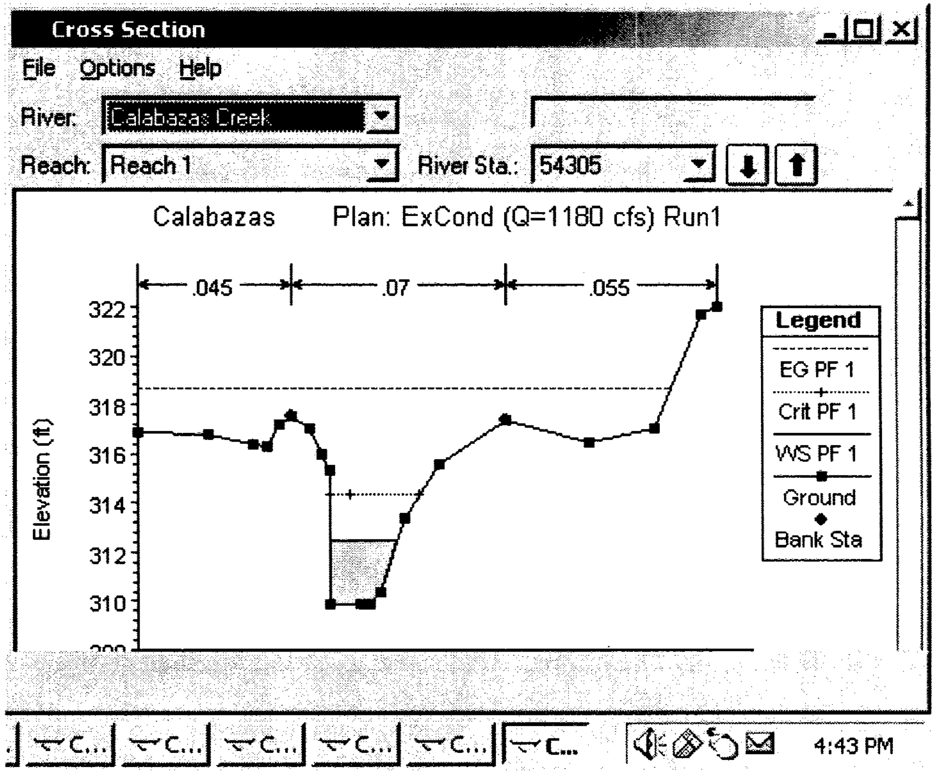
**Main Channel Bank Stations**

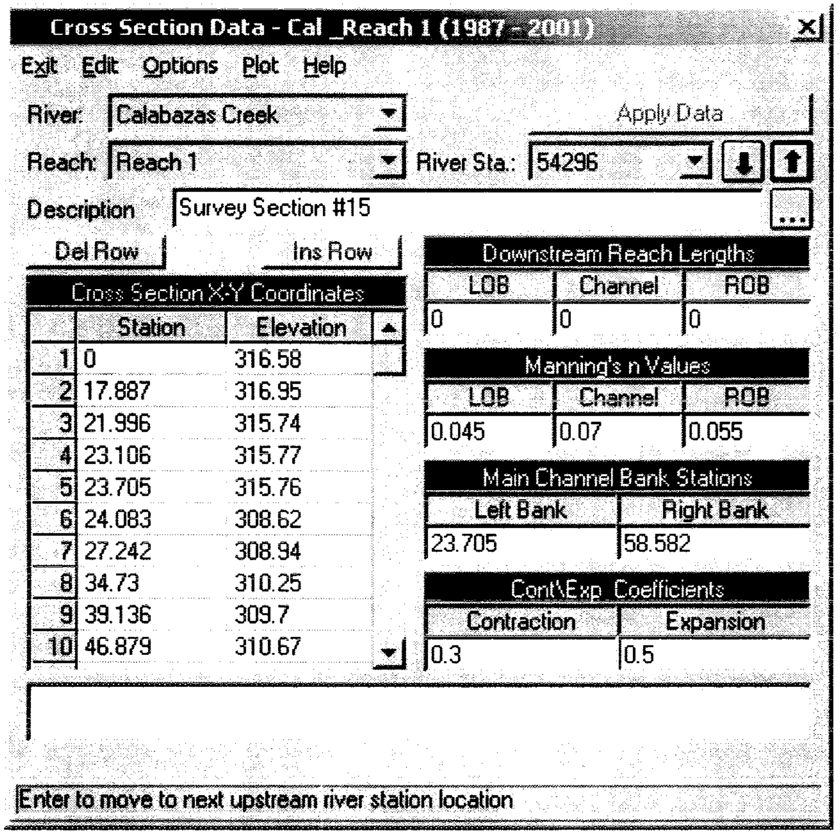
| Left Bank | Right Bank |
|---|---|
| 62.7 | 150.5 |

**Cont\Exp Coefficients**

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Edit Cross Section Description





River: Calabazas Creek

Reach: Reach 1

River Sta.: 54296

Description: Survey Section #15

Cross Section X-Y Coordinates

| | Station | Elevation |
|---|---|---|
| 1 | 0 | 316.58 |
| 2 | 17.887 | 316.95 |
| 3 | 21.996 | 315.74 |
| 4 | 23.106 | 315.77 |
| 5 | 23.705 | 315.76 |
| 6 | 24.083 | 308.62 |
| 7 | 27.242 | 308.94 |
| 8 | 34.73 | 310.25 |
| 9 | 39.136 | 309.7 |
| 10 | 46.879 | 310.67 |

Downstream Reach Lengths

| LOB | Channel | ROB |
|---|---|---|
| 0 | 0 | 0 |

Manning's n Values

| LOB | Channel | ROB |
|---|---|---|
| 0.045 | 0.07 | 0.055 |

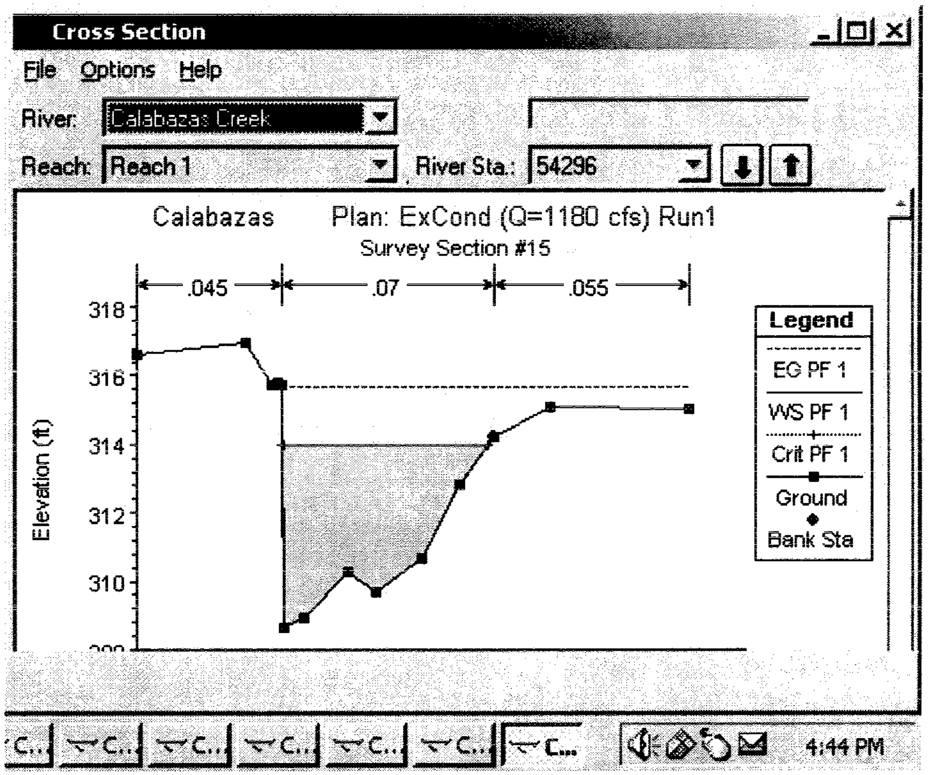
Main Channel Bank Stations

| Left Bank | Right Bank |
|---|---|
| 23.705 | 58.582 |

Cont\Exp Coefficients

| Contraction | Expansion |
|---|---|
| 0.3 | 0.5 |

Enter to move to next upstream river station location



River: Calabazas Creek

Reach: Reach 1

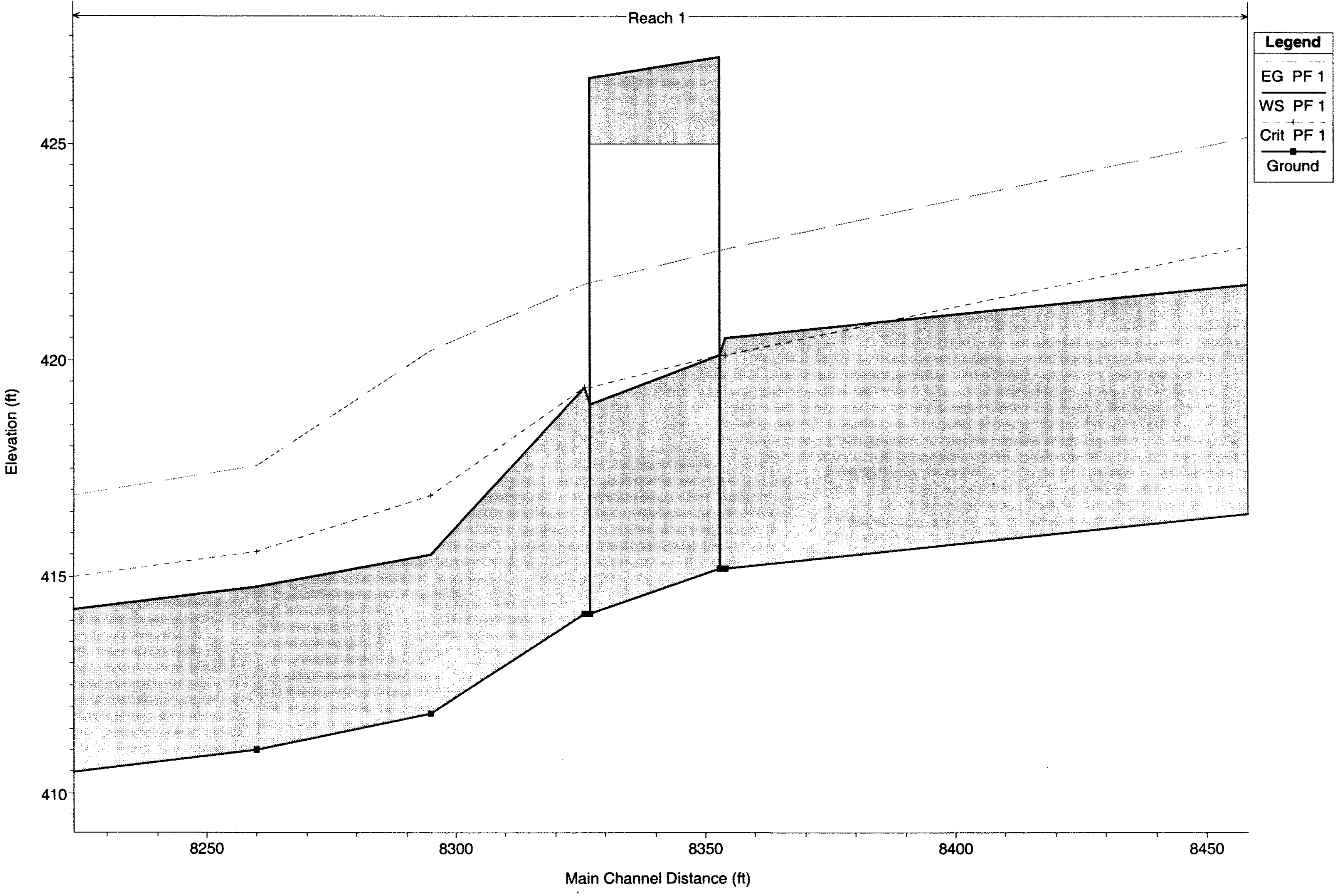
River Sta.: 54296

# APPENDIX F.2

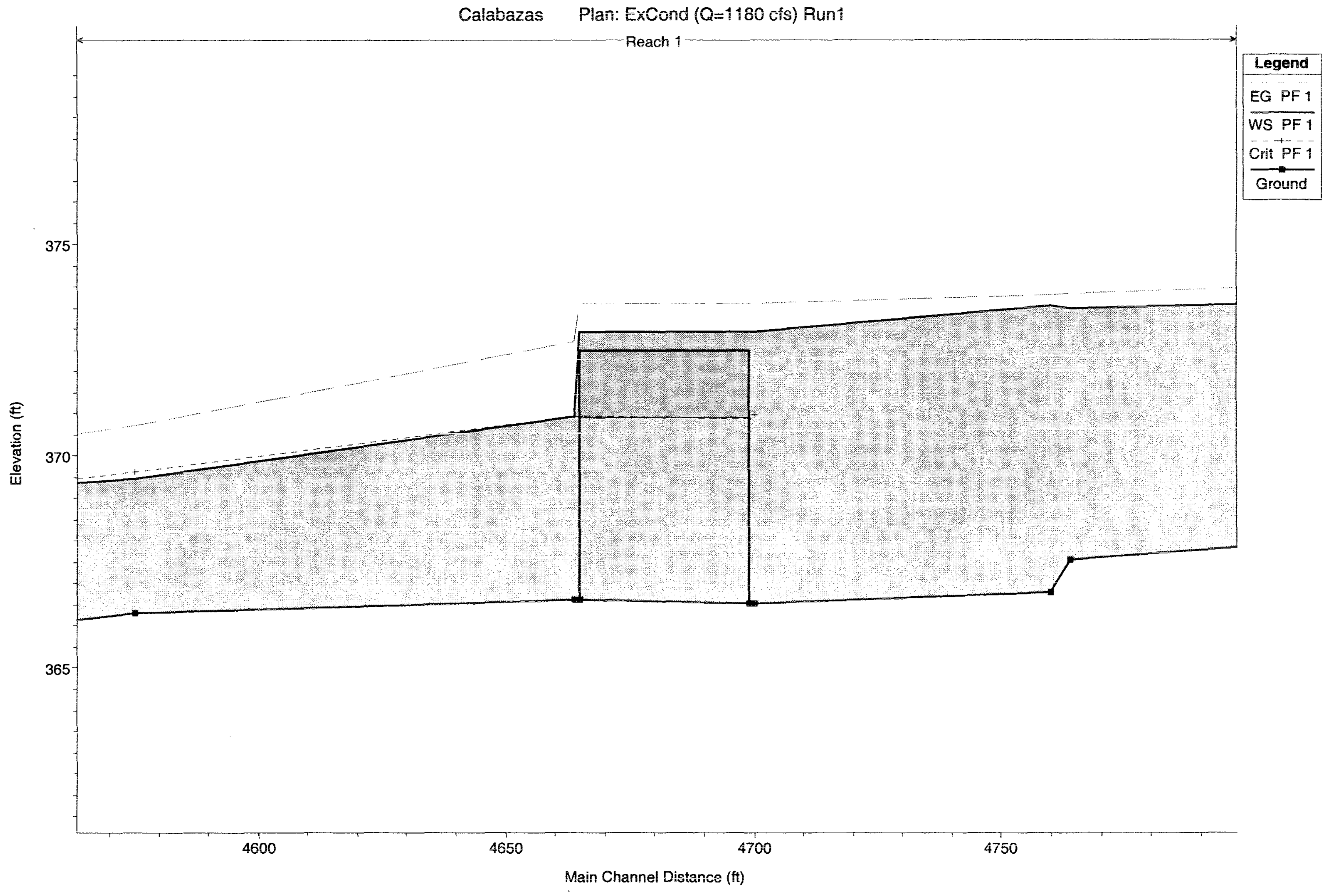
# OUTPUT SUMMARY

# Pierce Rd Bridge – Existing Conditions – 100 Year

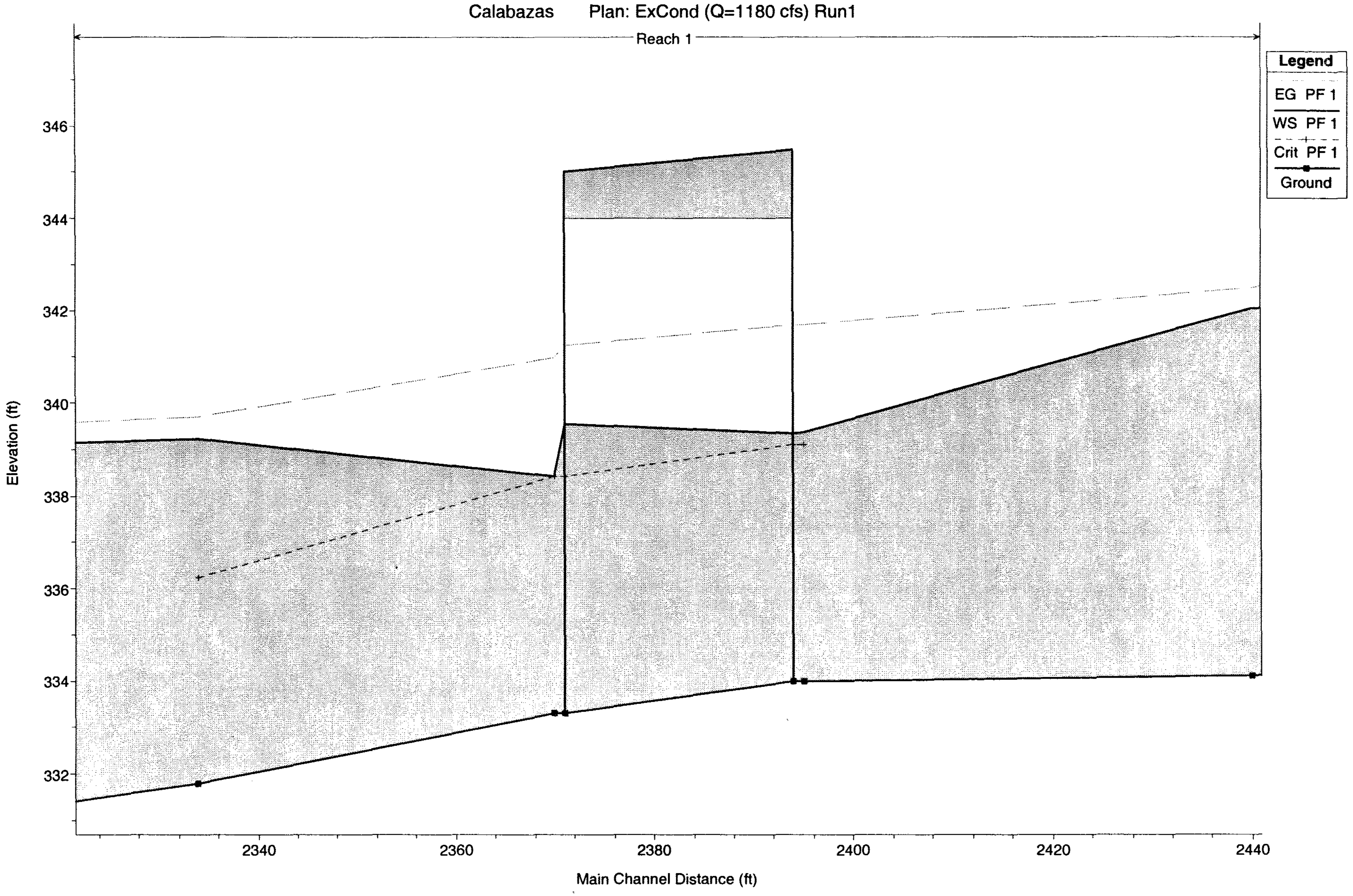
Calabazas Plan: ExCond (Q=1180 cfs) Run1



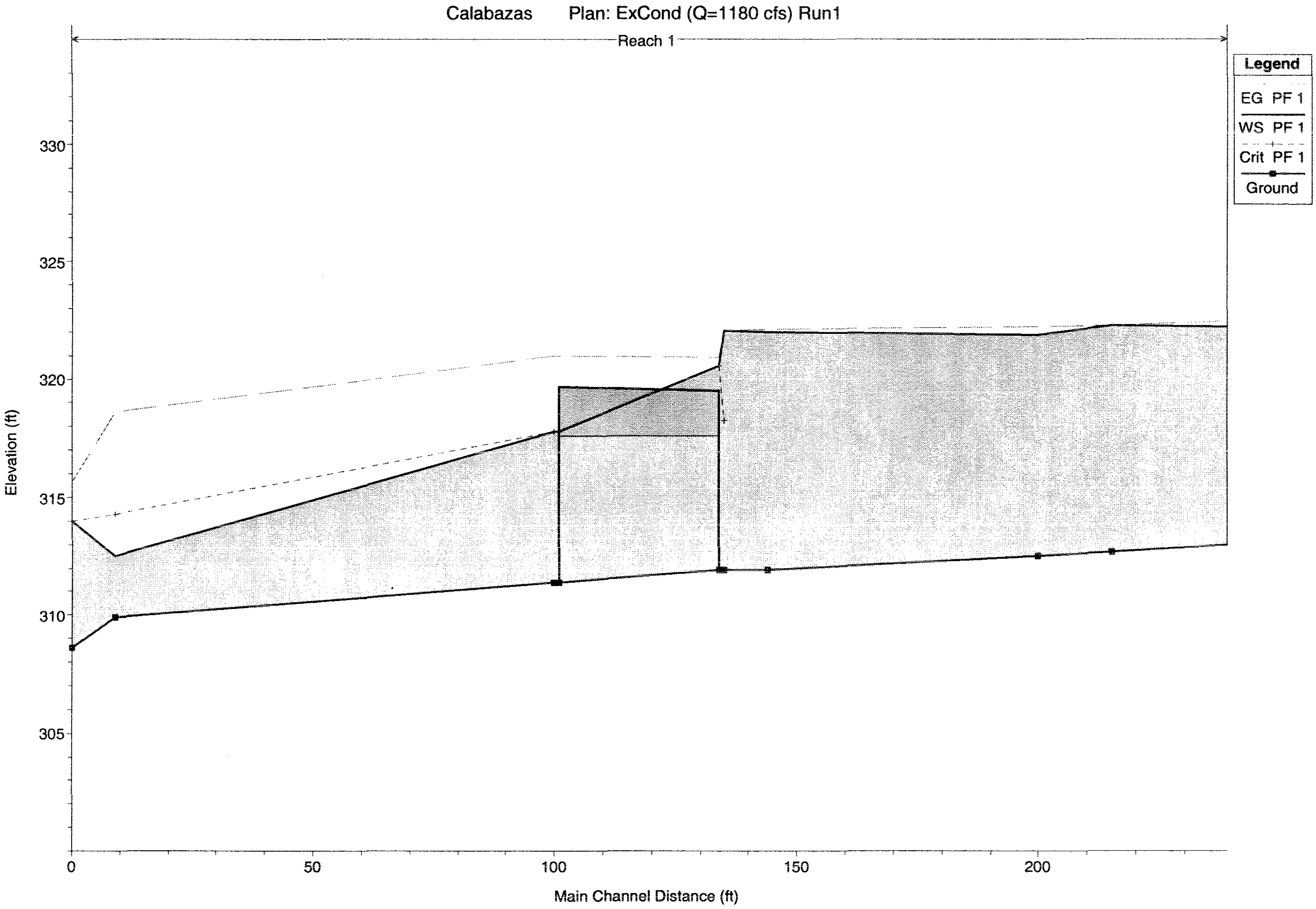
# Comer Dr Bridge – Existing Conditions – 100 Year



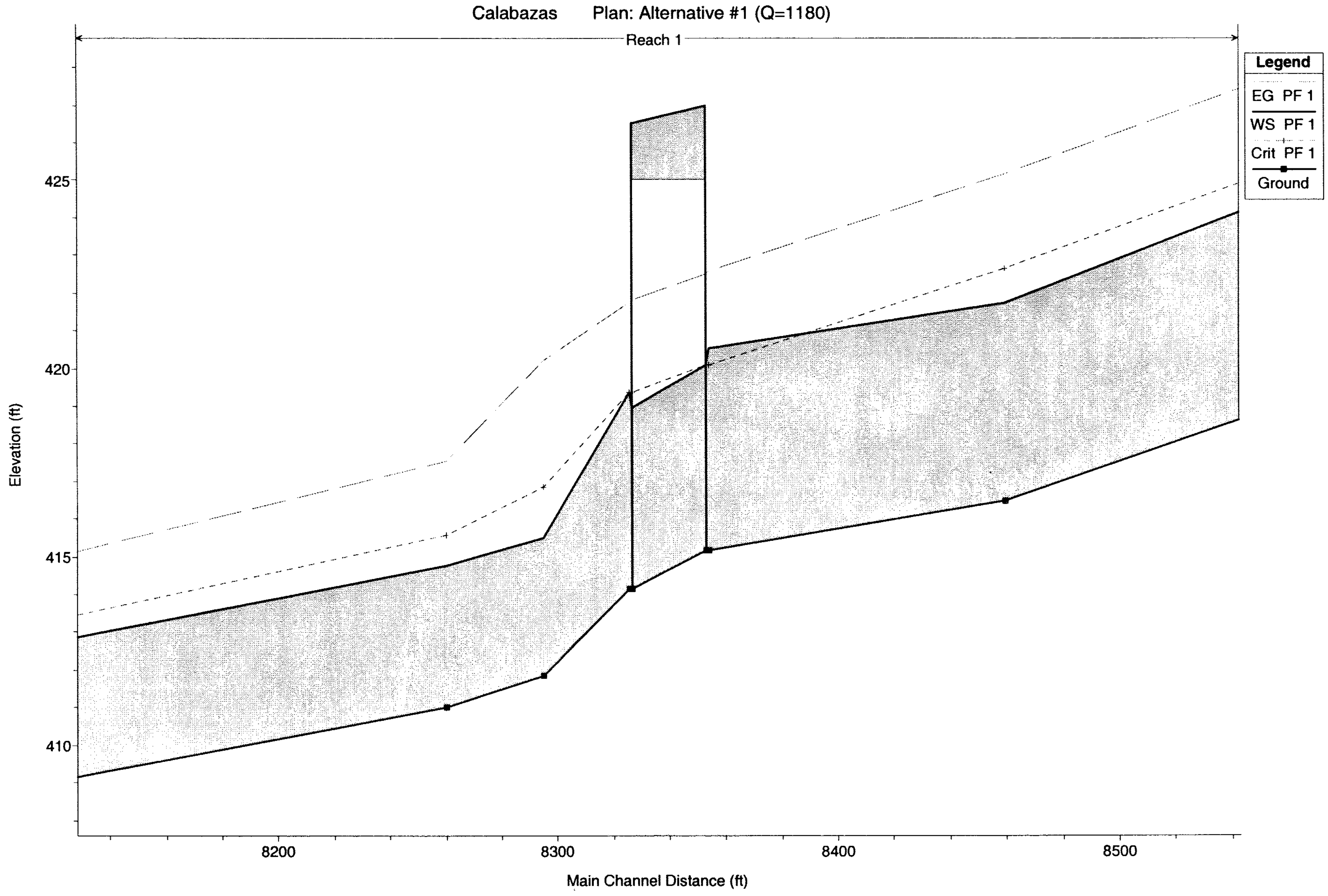
# Wardell Rd Bridge – Existing Conditions – 100 Year



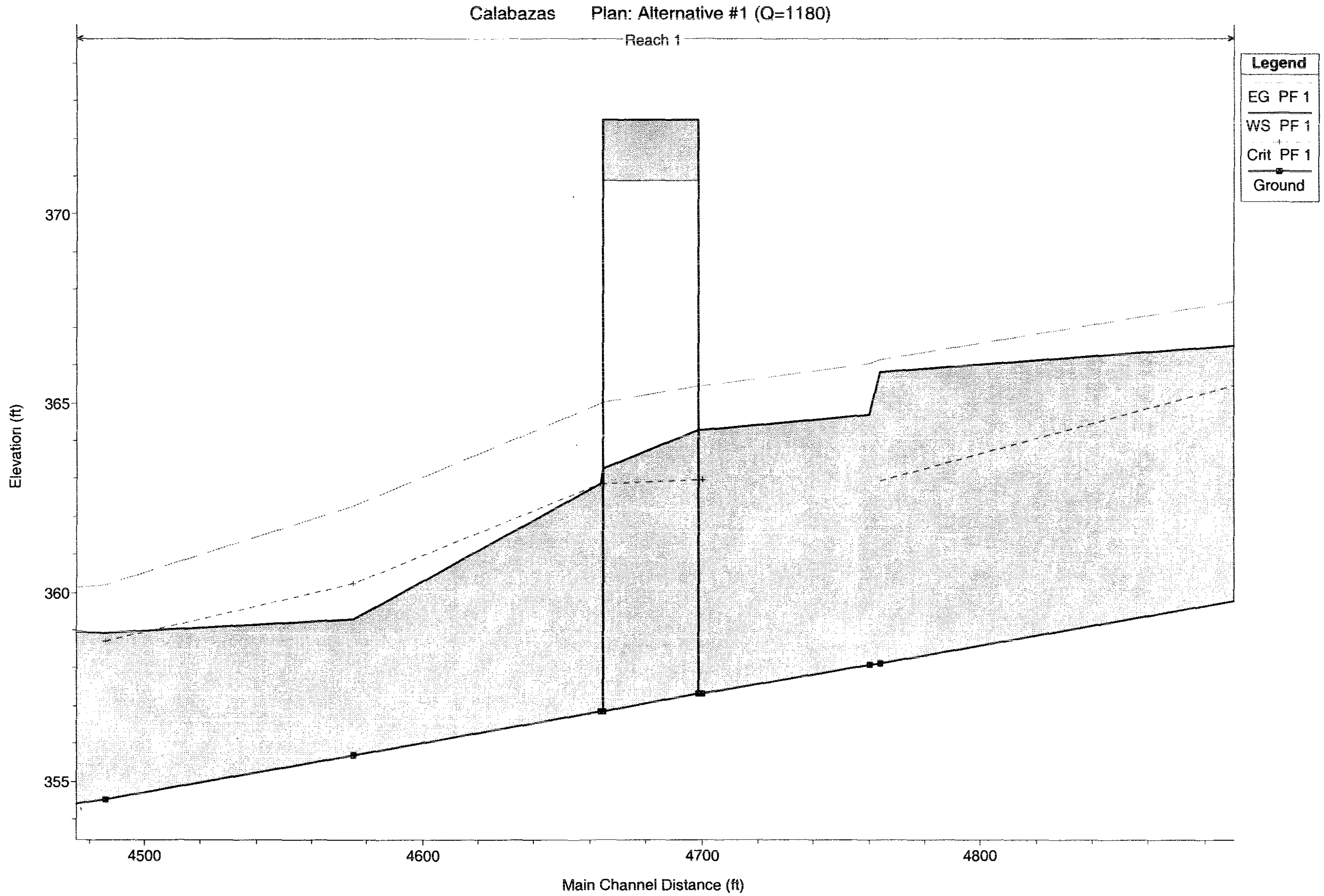
# UPRR – Existing Conditions – 100 Year



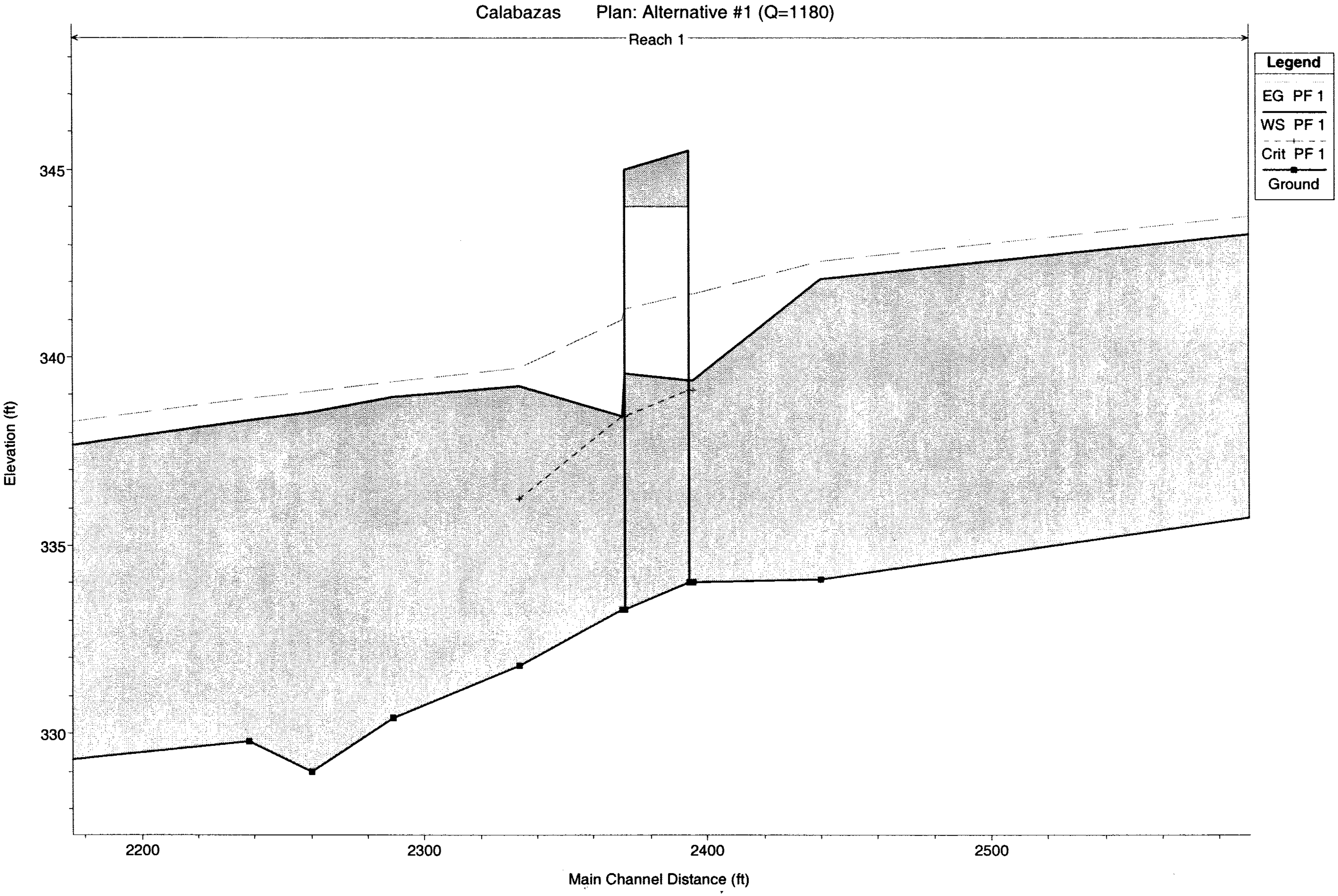
# Pierce Rd Bridge – Alternative #2 – 100 Year



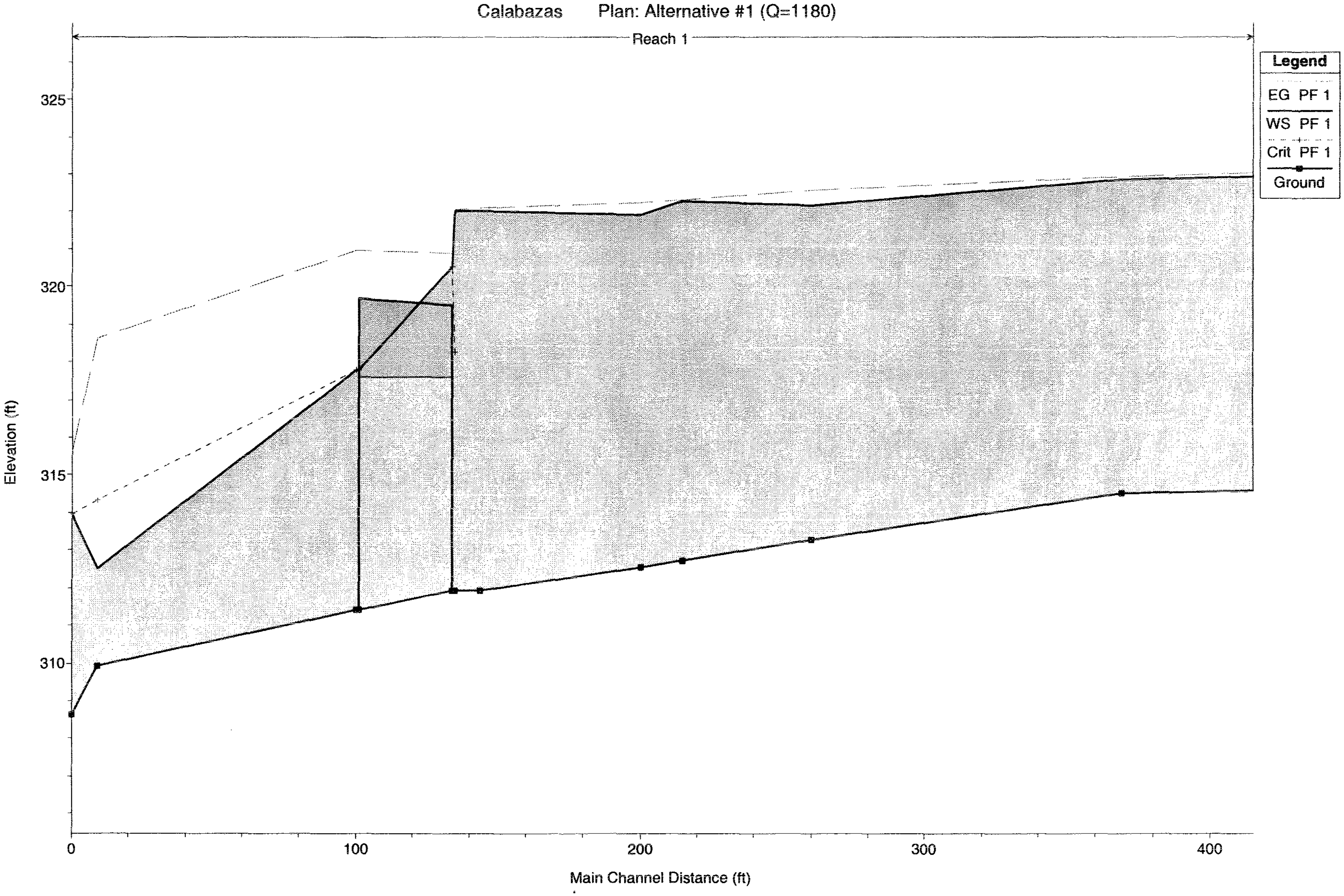
# Comer Dr Bridge – Alternative #2 – 100 Year



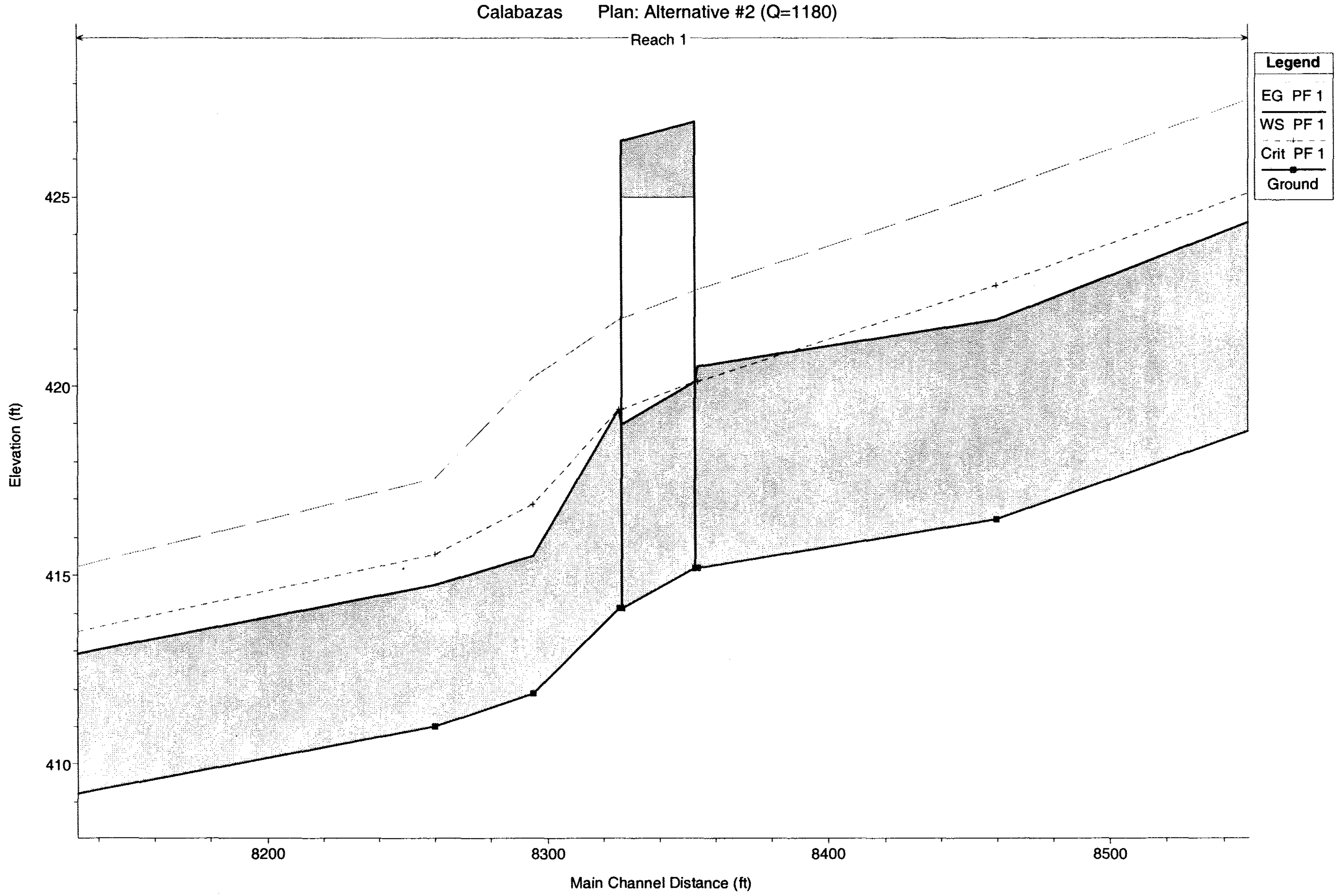
# Wardell Rd Bridge – Alternative #2 – 100 Year



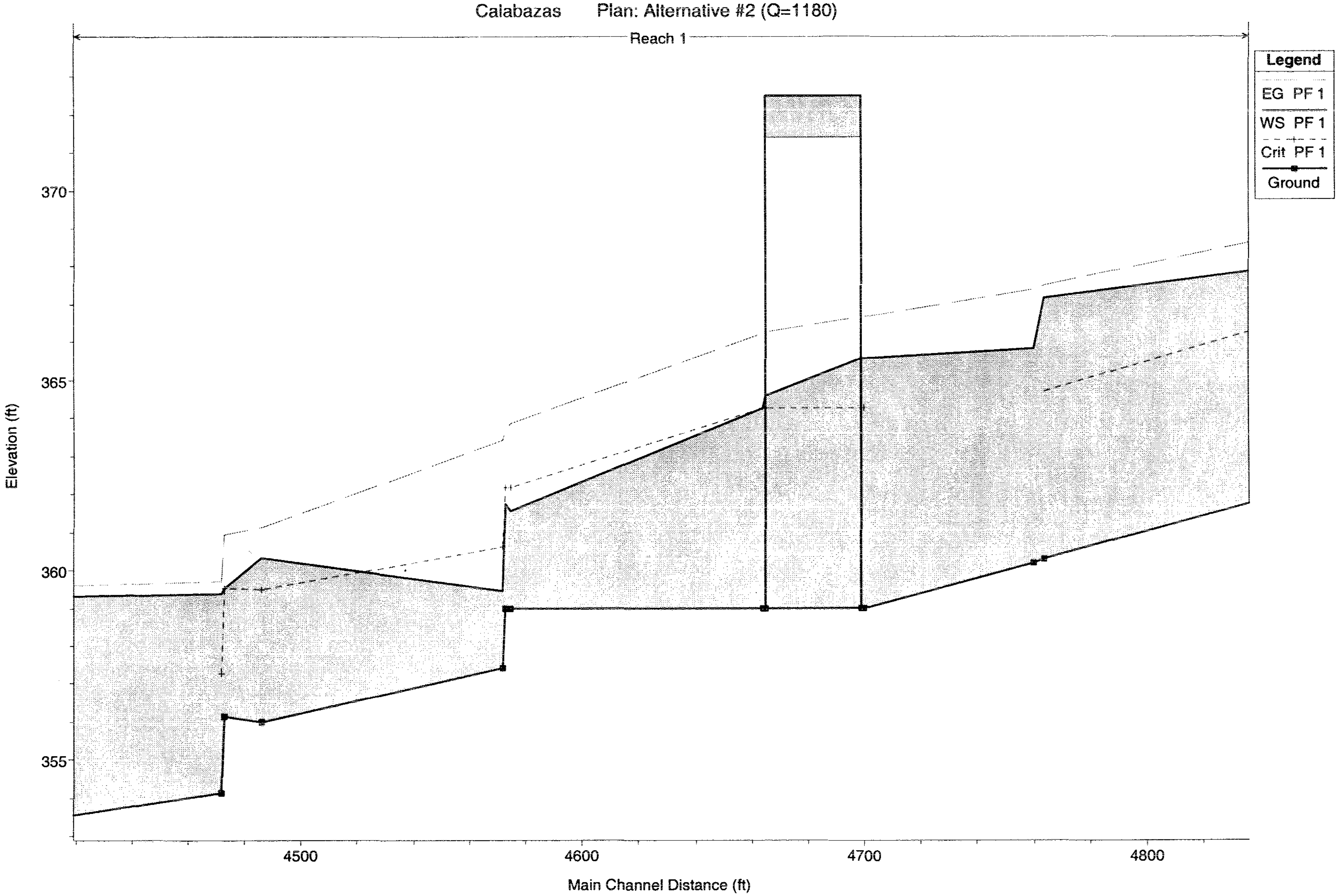
# UPRR – Alternative #2 – 100 Year



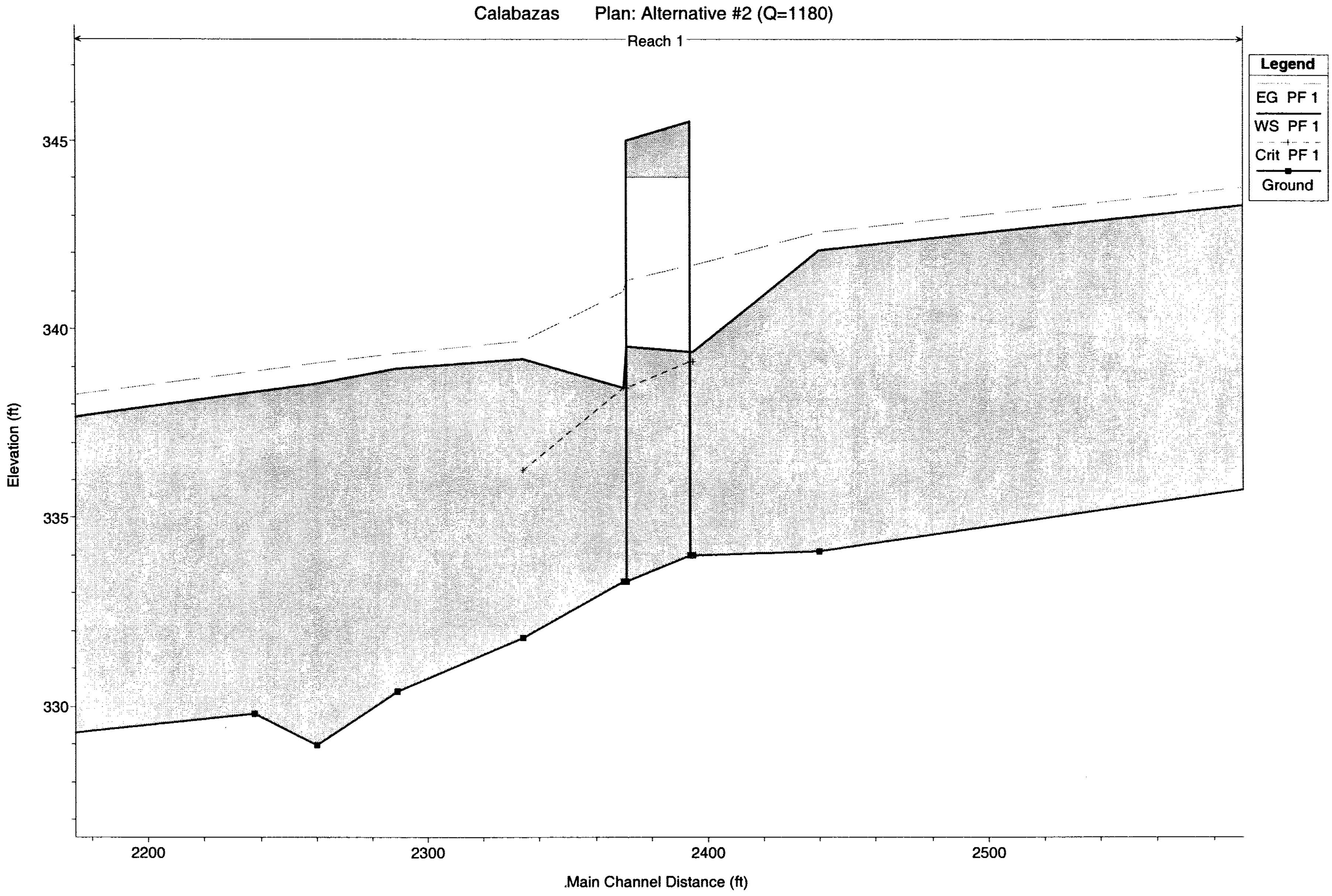
# Pierce Rd Bridge – Alternative #3 – 100 Year



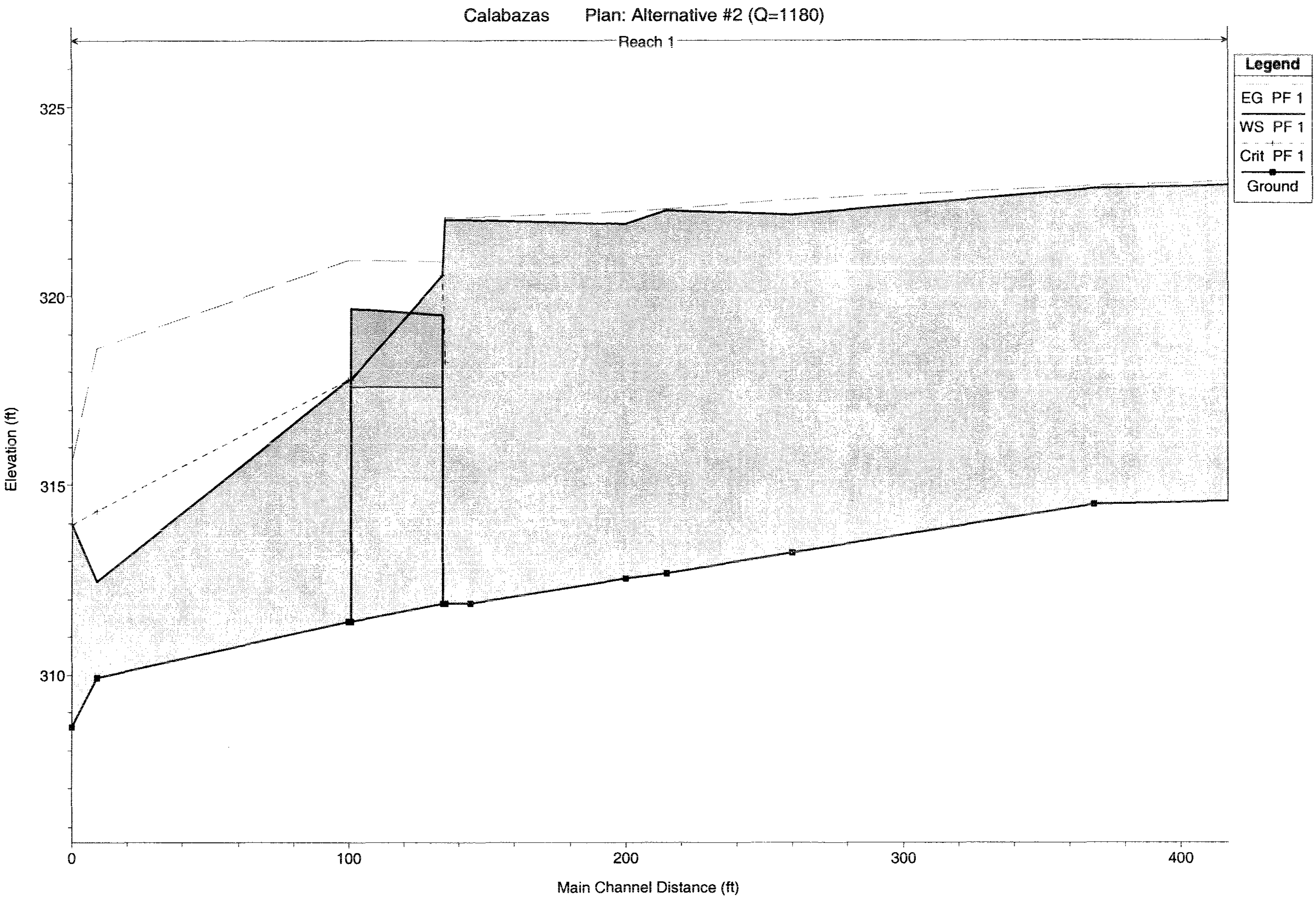
# Comer Dr Bridge – Alternative #3 – 100 Year



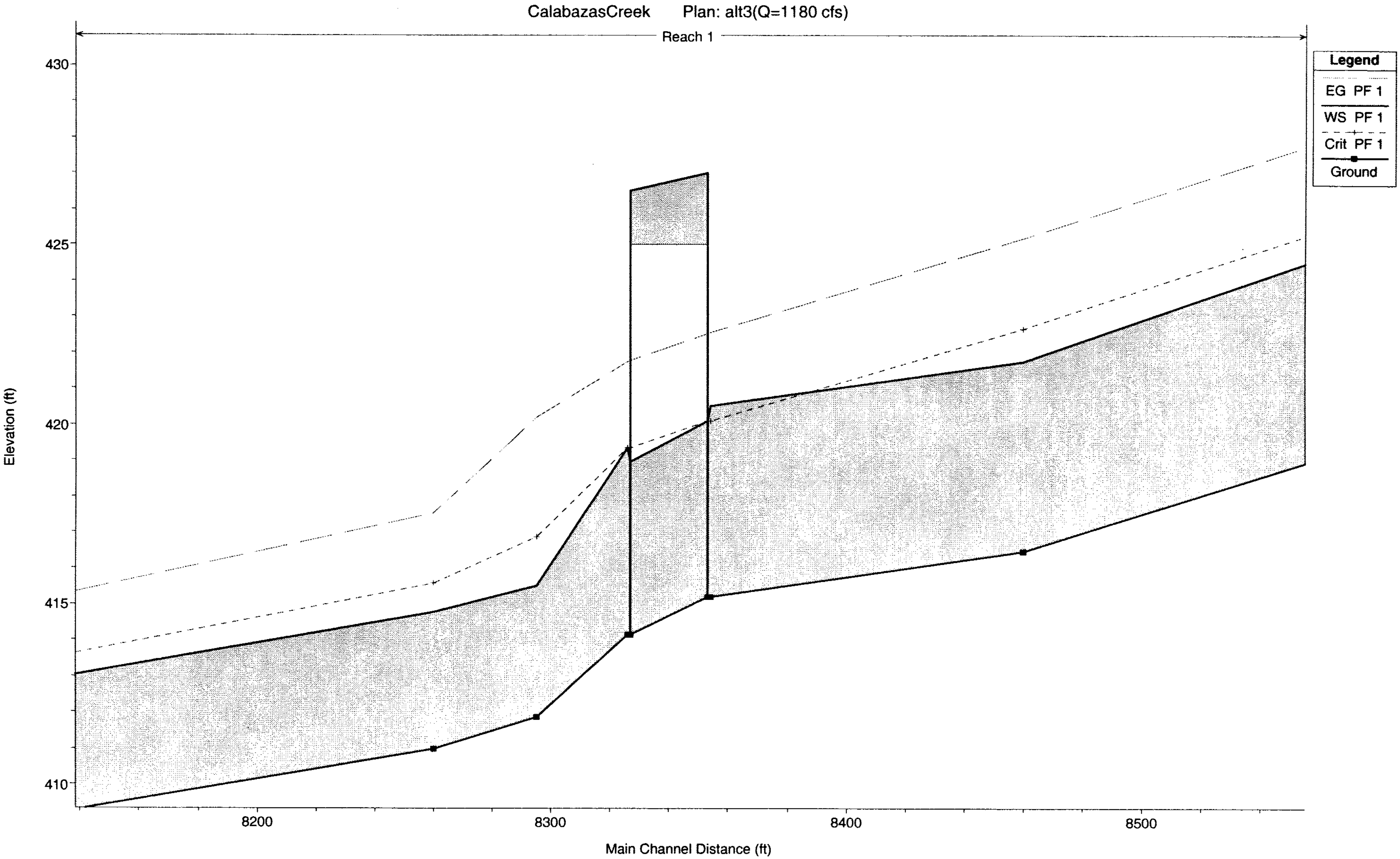
# Wardell Rd Bridge – Alternative #3 – 100 Year



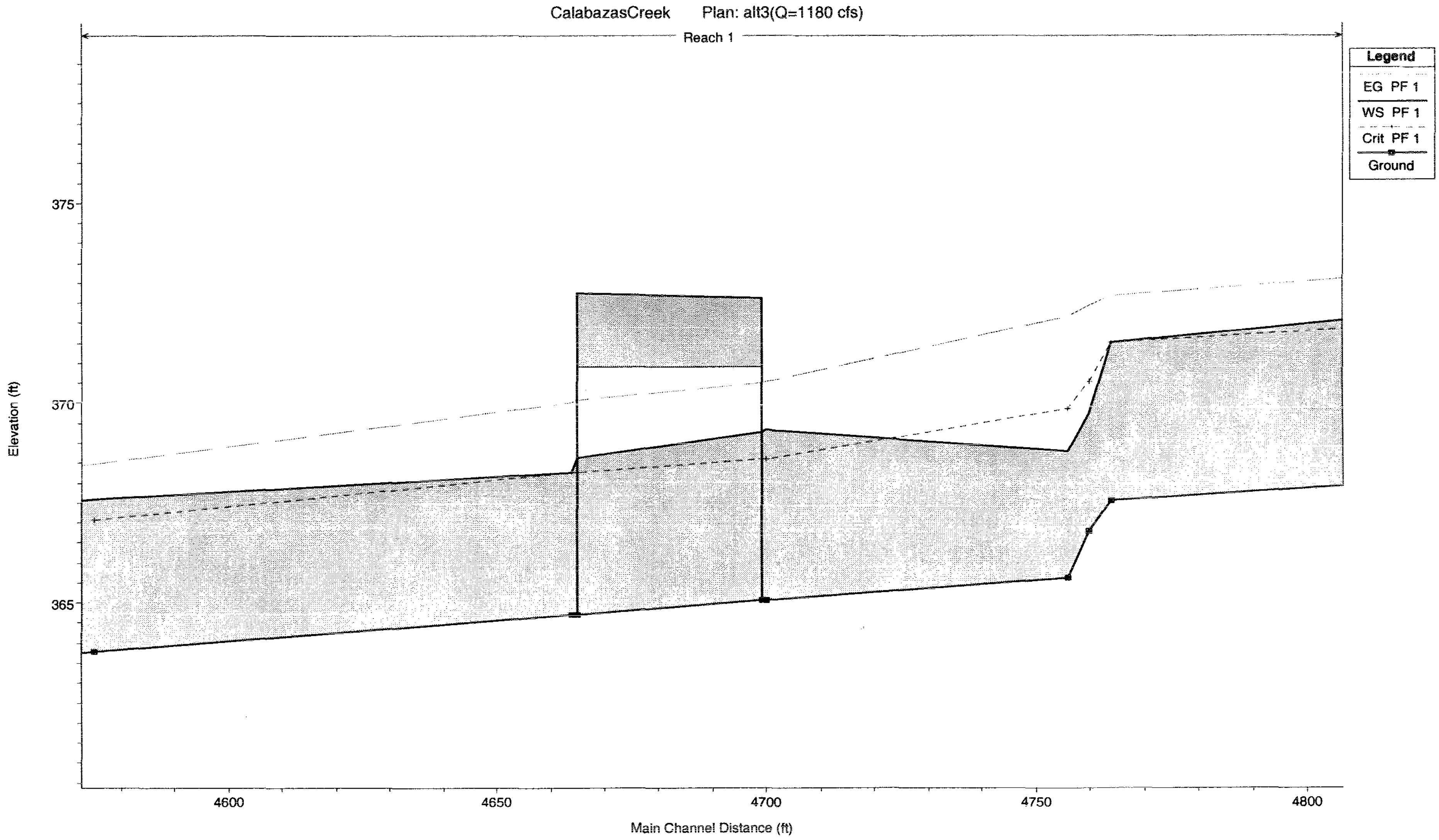
# UPRR – Alternative #3 – 100 Year



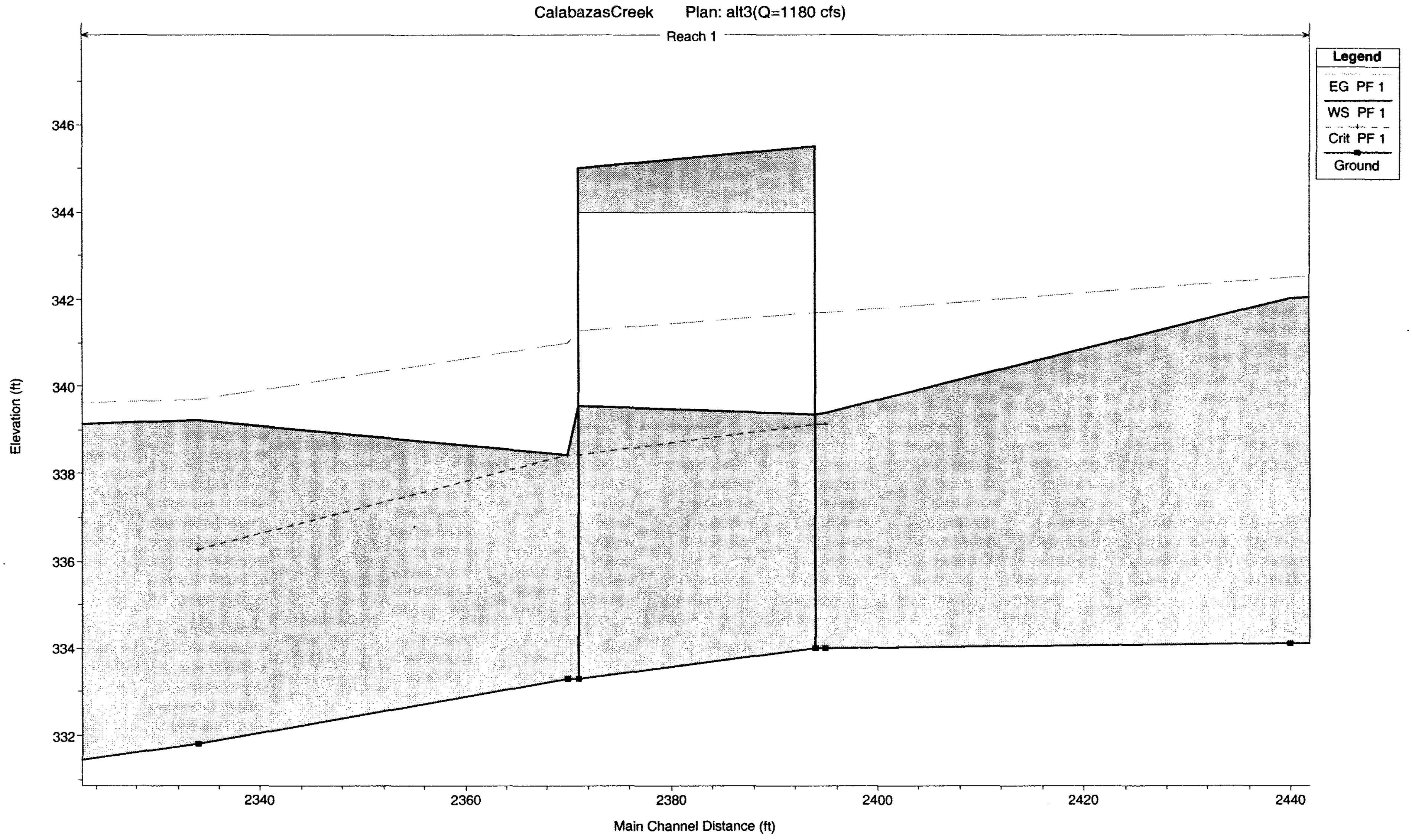
# Pierce Rd Bridge – Alternative #4 – 100 Year



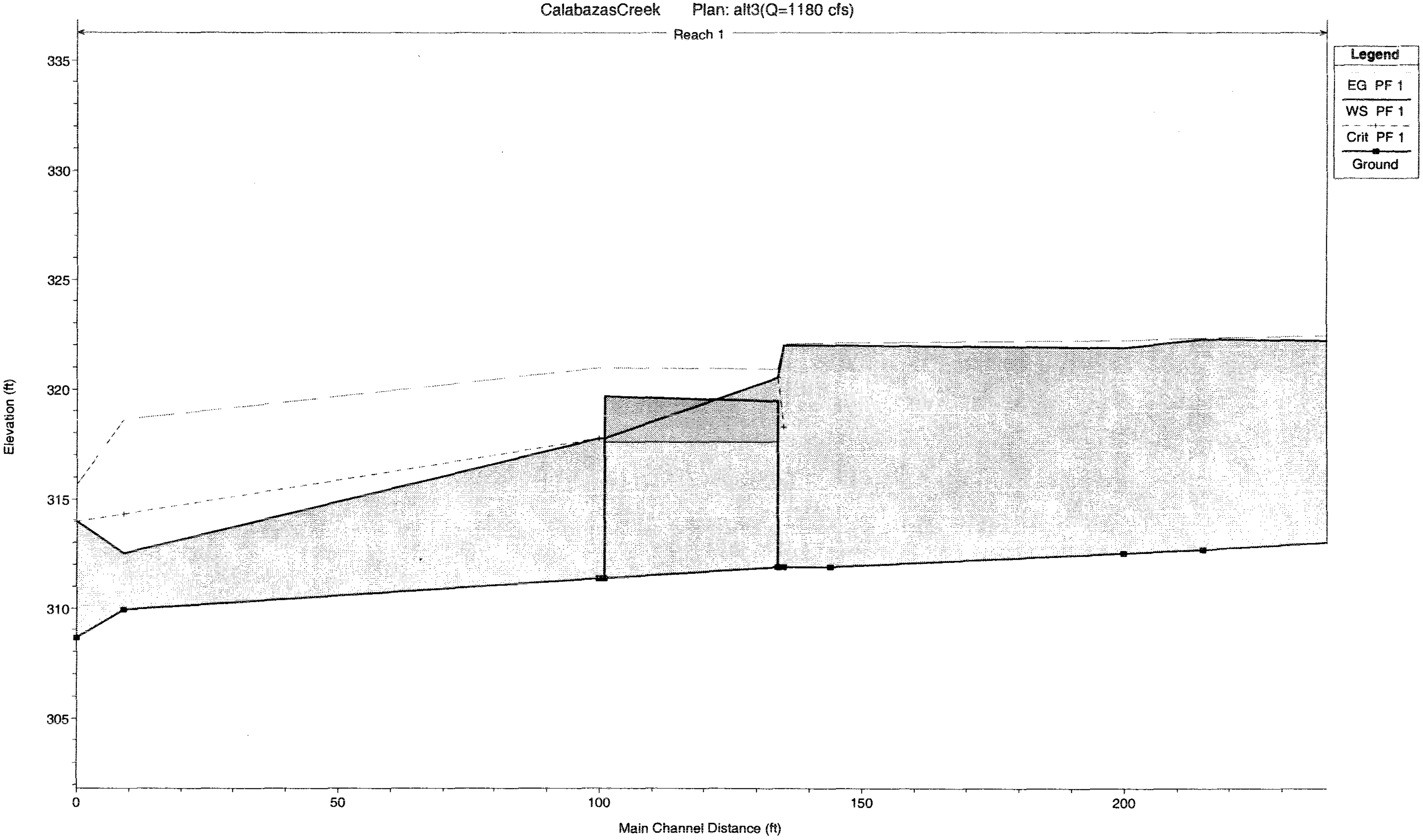
# Comer Dr Bridge – Alternative #4 – 100 Year



# Wardell Rd Bridge – Alternative #4 – 100 Year



# UPRR – Alternative #4 – 100 Year



## ExCond (Q=1180 cfs)

HEC-RAS Plan: ExCond (Q=1180 cfs) Run1 River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total<br>(cfs) | Min Ch El<br>(ft) | W.S. Elev<br>(ft) | Crit W.S.<br>(ft) | E.G. Elev<br>(ft) | E.G. Slope<br>(ft/ft) | Vel Chnl<br>(ft/s) | Flow Area<br>(sq ft) | Top Width<br>(ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 LIMIT | 1180 | 566 | 573.82 | 573.88 | 575.56 | 0.020001 | 10.58 | 111.54 | 33.7 | 1.02 |
| Reach 1 | 69496 | 1180 | 562 | 566.51 | 567.52 | 569.79 | 0.042289 | 14.53 | 81.2 | 29 | 1.53 |
| Reach 1 | 69196 | 1180 | 558 | 562.31 | 562.22 | 563.62 | 0.015854 | 9.17 | 128.68 | 45.15 | 0.96 |
| Reach 1 | 68696 | 1180 | 550 | 553.92 | 553.92 | 555.27 | 0.017596 | 9.32 | 126.64 | 47.55 | 1.01 |
| Reach 1 | 68396 | 1180 | 542 | 547.73 | 547.95 | 549.37 | 0.021868 | 10.29 | 114.65 | 43.07 | 1.11 |
| Reach 1 | 67796 | 1180 | 524 | 529.41 | 530.48 | 532.68 | 0.035765 | 14.51 | 81.32 | 24.05 | 1.39 |
| Reach 1 | 67396 | 1180 | 516 | 520.24 | 520.35 | 521.6 | 0.020131 | 9.34 | 126.32 | 52.64 | 1.06 |
| Reach 1 | 66996 | 1180 | 508.5 | 513.02 | 513.02 | 514.32 | 0.017431 | 9.17 | 128.71 | 49.36 | 1 |
| Reach 1 | 66865 | 1180 | 503.7 | 508.85 | 509.06 | 511.49 | 0.024842 | 13.03 | 90.59 | 19.65 | 1.07 |
| Reach 1 | 66850 VISTA | 1180 | 503 | 509.8 | 508.32 | 510.65 | 0.006115 | 7.38 | 159.96 | 36 | 0.62 |
| Reach 1 | 66796 REGINA | 1180 | 504 | 508.36 | 508.36 | 510.04 | 0.017439 | 10.42 | 113.23 | 33.98 | 1.01 |
| Reach 1 | 66396 | 1180 | 494 | 498.47 | 499.1 | 500.78 | 0.031708 | 12.21 | 96.65 | 37.27 | 1.34 |
| Reach 1 | 66246 | 1180 | 488 | 496.41 | 493.83 | 496.71 | 0.002316 | 4.41 | 267.39 | 66.47 | 0.39 |
| Reach 1 | 66245 | Bridge | VIA REGINA | | | | | | | | |
| Reach 1 | 66216 | 1180 | 488 | 493.53 | 493.53 | 494.8 | 0.018085 | 9.04 | 130.57 | 51.74 | 1 |
| Reach 1 | 66096 | 1180 | 484.5 | 487.92 | 488.91 | 490.95 | 0.062395 | 13.97 | 84.49 | 45.15 | 1.8 |
| Reach 1 | 65796 | 1180 | 476 | 480.14 | 480.14 | 481.59 | 0.017439 | 9.68 | 121.91 | 42.53 | 1.01 |
| Reach 1 | 65196 | 1180 | 466 | 470.71 | 469.65 | 471.32 | 0.006468 | 6.24 | 189.13 | 61.55 | 0.63 |
| Reach 1 | 64596 | 1180 | 454 | 462.43 | 462.43 | 464.71 | 0.021214 | 12.11 | 97.48 | 21.78 | 1.01 |
| Reach 1 | 63996 | 1180 | 442 | 447.28 | 447.92 | 449.89 | 0.029213 | 12.97 | 90.98 | 28.45 | 1.28 |
| Reach 1 | 63696 | 1180 | 436 | 441.98 | 441.98 | 443.74 | 0.017082 | 10.65 | 110.83 | 31.51 | 1 |
| Reach 1 | 63620 | 1180 | 434.1 | 441.96 | 439.05 | 442.55 | 0.003268 | 6.17 | 191.27 | 30.55 | 0.43 |
| Reach 1 | 63596 | 1180 | 433.7 | 442.02 | | 442.43 | 0.002105 | 5.14 | 229.74 | 33.71 | 0.35 |
| Reach 1 | 63396 | 1180 | 432 | 439.02 | 439.02 | 441.29 | 0.020075 | 12.1 | 97.54 | 21.79 | 1.01 |
| Reach 1 | 62796 | 1180 | 416.47 | 421.75 | 422.66 | 425.18 | 0.037094 | 14.86 | 79.41 | 20.68 | 1.34 |
| Reach 1 | 62690 | 1180 | 415.18 | 420.52 | 420.11 | 422.57 | 0.018313 | 11.48 | 102.82 | 19.65 | 0.88 |
| Reach 1 | 62689 | Bridge | PIERRE - CHALET CLOTHILDE | | | | | | | | |
| Reach 1 | 62662 | 1180 | 414.14 | 419.37 | 419.37 | 421.73 | 0.023588 | 12.35 | 95.57 | 20.19 | 1 |
| Reach 1 | 62631 | 1180 | 411.86 | 415.5 | 416.86 | 420.22 | 0.089783 | 17.43 | 67.71 | 33.43 | 2.16 |
| Reach 1 | 62596 | 1180 | 411 | 414.77 | 415.57 | 417.56 | 0.042249 | 13.4 | 88.07 | 36.31 | 1.52 |
| Reach 1 | 62096 | 1180 | 404 | 407.56 | 407.49 | 408.43 | 0.017868 | 7.45 | 158.35 | 85.51 | 0.97 |
| Reach 1 | 61696 | 1180 | 398 | 403.24 | | 403.86 | 0.0077 | 6.32 | 186.7 | 67.65 | 0.67 |
| Reach 1 | 61396 | 1180 | 394 | 399.75 | | 401 | 0.011566 | 8.97 | 131.58 | 36.78 | 0.84 |
| Reach 1 | 60896 | 1180 | 386.5 | 392.28 | 392.28 | 393.93 | 0.017423 | 10.33 | 114.27 | 34.65 | 1 |
| Reach 1 | 60396 | 1180 | 379.6 | 385.8 | 383.67 | 386.16 | 0.002895 | 4.86 | 242.64 | 62.32 | 0.43 |
| Reach 1 | 59796 | 1180 | 377.4 | 381.31 | 381.31 | 382.54 | 0.017921 | 8.92 | 132.3 | 53.93 | 1 |
| Reach 1 | 59500 | 1180 | 371.24 | 375.13 | 375.28 | 376.23 | 0.025499 | 8.44 | 139.79 | 80.59 | 1.13 |
| Reach 1 | 59396 | 1180 | 368.2 | 374.76 | 371.61 | 374.9 | 0.000941 | 3.04 | 389.13 | 91.55 | 0.25 |
| Reach 1 | 59300 | 1180 | 369.28 | 374.1 | | 374.68 | 0.006063 | 6.07 | 194.28 | 61.61 | 0.6 |
| Reach 1 | 59100 | 1180 | 367.57 | 373.5 | | 373.84 | 0.002645 | 4.63 | 255.1 | 63.64 | 0.41 |
| Reach 1 | 59096 | 1180 | 366.8 | 373.54 | | 373.81 | 0.001318 | 4.34 | 312.92 | 78.29 | 0.31 |
| Reach 1 | 59036 | 1180 | 366.52 | 372.95 | 370.99 | 373.63 | 0.004771 | 6.64 | 184.16 | 59.56 | 0.51 |
| Reach 1 | 59035 | Bridge | [illegible] | | | | | | | | |
| Reach 1 | 59000 | 1180 | 366.62 | 370.96 | 370.96 | 372.71 | 0.019541 | 10.62 | 111.12 | 32.18 | 1.01 |
| Reach 1 | 58911 | 1180 | 366.29 | 369.47 | 369.62 | 370.71 | 0.022121 | 8.92 | 132.31 | 63.76 | 1.09 |
| Reach 1 | 58822 | 1180 | 365.08 | 368.67 | 368.41 | 369.24 | 0.012479 | 6.05 | 195 | 108.64 | 0.8 |
| Reach 1 | 58733 | 1180 | 363.34 | 366.74 | 366.74 | 367.83 | 0.01927 | 8.36 | 141.09 | 65.09 | 1 |
| Reach 1 | 58708 | 1180 | 353.05 | 354.41 | 356.27 | 365.48 | 0.494058 | 26.7 | 44.19 | 41.21 | 4.54 |
| Reach 1 | 58658 | 1180 | 353.45 | 357.38 | 357.76 | 359.23 | 0.026501 | 10.91 | 108.17 | 43.55 | 1.22 |
| Reach 1 | 58608 | 1180 | 352.81 | 357.35 | 357.09 | 358.39 | 0.013487 | 8.19 | 144.11 | 53.86 | 0.88 |
| Reach 1 | 58508 | 1180 | 351.32 | 356.9 | | 357.47 | 0.005066 | 6.07 | 194.56 | 53.51 | 0.56 |

# ExCond (Q=1180 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58308 | 1180 | 349.09 | 354.52 | 354.14 | 355.87 | 0.012643 | 9.31 | 126.79 | 35.35 | 0.87 |
| Reach 1 | 58108 | 1180 | 346.97 | 353.5 | | 354.12 | 0.005144 | 6.32 | 186.69 | 47.31 | 0.56 |
| Reach 1 | 57975 | 1180 | 345.1 | 352.96 | | 353.53 | 0.003674 | 6.07 | 194.38 | 37.02 | 0.47 |
| Reach 1 | 57804 | 1180 | 343.8 | 352.59 | | 352.82 | 0.003414 | 3.83 | 307.85 | 52.39 | 0.28 |
| Reach 1 | 57619 | 1180 | 342.5 | 352.06 | | 352.25 | 0.00259 | 3.5 | 337.28 | 52.94 | 0.24 |
| Reach 1 | 57558 | 1180 | 341.78 | 351.67 | | 352 | 0.004871 | 4.62 | 255.67 | 40.4 | 0.32 |
| Reach 1 | 57509 | 1180 | 341.9 | 351.56 | | 351.76 | 0.00258 | 3.58 | 329.17 | 48.21 | 0.24 |
| Reach 1 | 57388 | 1180 | 340.6 | 350.64 | | 350.74 | 0.152379 | 2.56 | 461.55 | 77.46 | 0.18 |
| Reach 1 | 57188 | 1180 | 339.1 | 345.98 | | 346.4 | 0.007999 | 5.25 | 224.95 | 45.34 | 0.42 |
| Reach 1 | 57058 | 1180 | 337.19 | 344.41 | | 345.03 | 0.013059 | 6.34 | 186.1 | 39.8 | 0.52 |
| Reach 1 | 56979 | 1180 | 336.3 | 343.68 | | 344.14 | 0.00827 | 5.47 | 215.56 | 40.82 | 0.42 |
| Reach 1 | 56776 | 1180 | 334.1 | 342.04 | | 342.51 | 0.007891 | 5.47 | 215.72 | 38.53 | 0.41 |
| Reach 1 | 56731 | 1180 | 334 | 339.38 | 339.13 | 341.7 | 0.004065 | 12.23 | 96.7 | 18.03 | 0.93 |
| Reach 1 | 56730 Bridge WARDELL | | | | | | | | | | |
| Reach 1 | 56706 | 1180 | 333.3 | 338.42 | 338.42 | 340.98 | 0.006143 | 12.83 | 92.01 | 18.02 | 1 |
| Reach 1 | 56670 | 1180 | 331.8 | 339.22 | 336.26 | 339.7 | 0.008226 | 5.54 | 213.15 | 38.85 | 0.42 |
| Reach 1 | 56625 | 1180 | 330.4 | 338.93 | | 339.35 | 0.00614 | 5.16 | 228.85 | 33.64 | 0.35 |
| Reach 1 | 56596 | 1180 | 328.97 | 338.54 | | 339.1 | 0.008542 | 5.96 | 197.95 | 27.81 | 0.39 |
| Reach 1 | 56574 | 1180 | 329.8 | 338.32 | | 338.89 | 0.009497 | 6.08 | 194.14 | 31.58 | 0.43 |
| Reach 1 | 56474 | 1180 | 329 | 337.29 | | 337.9 | 0.010308 | 6.25 | 188.92 | 31.57 | 0.45 |
| Reach 1 | 56275 | 1180 | 327.3 | 335.41 | | 335.95 | 0.009027 | 5.92 | 199.33 | 32.37 | 0.42 |
| Reach 1 | 56200 | 1180 | 326.4 | 335.24 | | 335.45 | 0.002662 | 3.67 | 324.62 | 61.6 | 0.24 |
| Reach 1 | 56100 | 1180 | 326 | 334.93 | | 335.14 | 0.003416 | 3.91 | 331.78 | 98.51 | 0.27 |
| Reach 1 | 56074 | 1180 | 325.18 | 334.13 | | 334.84 | 0.012385 | 6.78 | 175.45 | 34.59 | 0.48 |
| Reach 1 | 56058 | 1180 | 325.18 | 333.8 | | 334.6 | 0.01463 | 7.17 | 164.83 | 30.37 | 0.52 |
| Reach 1 | 56000 | 1180 | 325.7 | 333.44 | | 333.82 | 0.007062 | 5.13 | 275.37 | 167.57 | 0.38 |
| Reach 1 | 55902 | 1180 | 323.9 | 333.02 | | 333.2 | 0.004139 | 3.8 | 375.19 | 180.06 | 0.29 |
| Reach 1 | 55872 | 1180 | 323.8 | 332.28 | | 332.87 | 0.010699 | 6.2 | 190.37 | 34.62 | 0.47 |
| Reach 1 | 55800 | 1180 | 323.4 | 331.53 | | 332.1 | 0.010709 | 6.1 | 205.28 | 100.42 | 0.46 |
| Reach 1 | 55706 | 1180 | 322.4 | 330.79 | | 331.19 | 0.007264 | 5.29 | 261.37 | 139.16 | 0.39 |
| Reach 1 | 55606 | 1180 | 320.3 | 330.34 | | 330.58 | 0.004134 | 4.22 | 332.21 | 147.79 | 0.29 |
| Reach 1 | 55558 | 1180 | 321.08 | 328.53 | | 329.85 | 0.025807 | 9.23 | 129.63 | 25.95 | 0.65 |
| Reach 1 | 55505 | 1180 | 319.6 | 328.62 | | 328.87 | 0.00399 | 4.18 | 314.68 | 97.84 | 0.28 |
| Reach 1 | 55405 | 1180 | 319.1 | 327.68 | | 328.19 | 0.009961 | 6 | 220.81 | 82.17 | 0.42 |
| Reach 1 | 55306 | 1180 | 318.3 | 326.9 | | 327.21 | 0.008021 | 4.75 | 274.96 | 115.81 | 0.4 |
| Reach 1 | 55206 | 1180 | 318 | 326.33 | | 326.53 | 0.005105 | 3.84 | 330.61 | 119.57 | 0.32 |
| Reach 1 | 55108 | 1180 | 316.46 | 324.58 | | 325.45 | 0.01945 | 7.6 | 162.03 | 43.76 | 0.6 |
| Reach 1 | 55005 | 1180 | 316.1 | 323.98 | | 324.19 | 0.005261 | 3.93 | 324.79 | 125.54 | 0.32 |
| Reach 1 | 54905 | 1180 | 315.7 | 323.39 | | 323.6 | 0.006511 | 3.93 | 327.84 | 148.16 | 0.35 |
| Reach 1 | 54805 | 1180 | 314.7 | 323.02 | | 323.13 | 0.002954 | 2.62 | 443.2 | 159.29 | 0.24 |
| Reach 1 | 54705 | 1180 | 314.5 | 322.85 | | 322.93 | 0.001315 | 2.53 | 563.31 | 240 | 0.18 |
| Reach 1 | 54596 | 1180 | 313.25 | 322.16 | | 322.56 | 0.00605 | 5.26 | 241.06 | 58.91 | 0.36 |
| Reach 1 | 54511 | 1180 | 312.7 | 322.27 | | 322.31 | 0.000689 | 1.72 | 745.48 | 215 | 0.13 |
| Reach 1 | 54496 | 1180 | 312.53 | 321.9 | | 322.22 | 0.000195 | 4.84 | 403.37 | 105.45 | 0.31 |
| Reach 1 | 54440 | 1180 | 311.9 | 322.01 | | 322.1 | 0.000126 | 3.49 | 1084.65 | 400 | 0.2 |
| Reach 1 | 54431 | 1180 | 311.9 | 322.02 | 318.28 | 322.07 | 0.000126 | 2.97 | 1522.92 | 790 | 0.17 |
| Reach 1 | 54430 Bridge Springdale | | | | | | | | | | |
| Reach 1 | 54396 | 1180 | 311.4 | 317.78 | 317.78 | 320.97 | 0.004401 | 14.33 | 82.33 | 13.02 | 1 |
| Reach 1 | 54305 | 1180 | 309.9 | 312.48 | 314.31 | 318.63 | 0.35638 | 19.9 | 59.29 | 27.5 | 2.39 |
| Reach 1 | 54296 | 1180 | 308.62 | 313.97 | 313.97 | 315.65 | 0.059007 | 10.4 | 113.45 | 33.79 | 1 |

# ExCond (Q=580 cfs)

HEC-RAS Plan: ExCond (Q=580 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 580 | 566 | 572.05 | 572.05 | 573.43 | 0.021958 | 9.42 | 61.56 | 22.72 | 1.01 |
| Reach 1 | 69496 | 580 | 562 | 565.25 | 565.9 | 567.47 | 0.041143 | 11.96 | 48.5 | 22.84 | 1.45 |
| Reach 1 | 69196 | 580 | 558 | 561.16 | 560.93 | 561.96 | 0.014354 | 7.19 | 80.61 | 37.98 | 0.87 |
| Reach 1 | 68696 | 580 | 550 | 552.64 | 552.64 | 553.63 | 0.019423 | 8 | 72.52 | 36.91 | 1.01 |
| Reach 1 | 68396 | 580 | 542 | 546.52 | 546.57 | 547.63 | 0.020614 | 8.46 | 68.54 | 32.96 | 1.03 |
| Reach 1 | 67796 | 580 | 524 | 527.7 | 528.46 | 530.28 | 0.042543 | 12.89 | 45 | 18.33 | 1.45 |
| Reach 1 | 67396 | 580 | 516 | 519.21 | 519.11 | 520.07 | 0.017359 | 7.44 | 77.92 | 40.87 | 0.95 |
| Reach 1 | 66996 | 580 | 508.5 | 511.78 | 511.78 | 512.73 | 0.019305 | 7.83 | 74.07 | 38.96 | 1 |
| Reach 1 | 66865 | 580 | 503.7 | 506.47 | 507.11 | 508.95 | 0.043233 | 12.63 | 45.94 | 17.88 | 1.39 |
| Reach 1 | 66850 | 580 | 503 | 508.09 | 506.69 | 508.58 | 0.004974 | 5.62 | 103.22 | 30.32 | 0.54 |
| Reach 1 | 66796 | 580 | 504 | 506.86 | 506.86 | 508.04 | 0.019262 | 8.73 | 66.47 | 28.49 | 1.01 |
| Reach 1 | 66396 | 580 | 494 | 497.36 | 497.67 | 498.83 | 0.027894 | 9.71 | 59.72 | 29.53 | 1.2 |
| Reach 1 | 66246 | 580 | 488 | 491.83 | 492.39 | 493.75 | 0.04103 | 11.14 | 52.06 | 27.51 | 1.43 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 580 | 488 | 492.22 | 492.23 | 493.22 | 0.02027 | 8.03 | 72.25 | 36.94 | 1.01 |
| Reach 1 | 66096 | 580 | 484.5 | 487.07 | 487.73 | 489.15 | 0.063085 | 11.58 | 50.09 | 35.81 | 1.73 |
| Reach 1 | 65796 | 580 | 476 | 478.82 | 478.82 | 479.86 | 0.019208 | 8.19 | 70.8 | 34.3 | 1 |
| Reach 1 | 65196 | 580 | 466 | 469.12 | 468.46 | 469.61 | 0.007924 | 5.59 | 103.82 | 46.53 | 0.66 |
| Reach 1 | 64596 | 580 | 454 | 459.86 | 459.86 | 461.79 | 0.024026 | 11.14 | 52.04 | 13.77 | 1.01 |
| Reach 1 | 63996 | 580 | 442 | 446.02 | 446.2 | 447.55 | 0.023071 | 9.91 | 58.55 | 23.1 | 1.1 |
| Reach 1 | 63696 | 580 | 436 | 440.33 | 440.33 | 441.6 | 0.018713 | 9.05 | 64.09 | 25.25 | 1 |
| Reach 1 | 63620 | 580 | 434.1 | 439.33 | 437.37 | 439.73 | 0.003625 | 5.12 | 113.39 | 28.38 | 0.45 |
| Reach 1 | 63596 | 580 | 433.7 | 439.37 | | 439.62 | 0.00199 | 4.04 | 143.64 | 31.21 | 0.33 |
| Reach 1 | 63396 | 580 | 432 | 436.87 | 436.87 | 438.54 | 0.021511 | 10.38 | 55.89 | 16.96 | 1.01 |
| Reach 1 | 62796 | 580 | 416.47 | 420.18 | 420.65 | 422.33 | 0.034656 | 11.77 | 49.29 | 18.12 | 1.26 |
| Reach 1 | 62690 | 580 | 415.18 | 418.66 | 418.27 | 419.85 | 0.015923 | 8.74 | 66.39 | 19.6 | 0.84 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 580 | 414.14 | 417.57 | 417.57 | 419.05 | 0.02347 | 9.77 | 59.39 | 20.06 | 1 |
| Reach 1 | 62631 | 580 | 411.86 | 414.7 | 415.57 | 417.64 | 0.086528 | 13.77 | 42.11 | 29.19 | 2.02 |
| Reach 1 | 62596 | 580 | 411 | 413.96 | 414.3 | 415.43 | 0.033175 | 9.71 | 59.75 | 33.7 | 1.28 |
| Reach 1 | 62096 | 580 | 404 | 406.85 | 406.58 | 407.34 | 0.013307 | 5.62 | 103.22 | 68.31 | 0.81 |
| Reach 1 | 61696 | 580 | 398 | 401.84 | | 402.37 | 0.011577 | 5.83 | 99.53 | 55.41 | 0.77 |
| Reach 1 | 61396 | 580 | 394 | 398.19 | | 399 | 0.010719 | 7.25 | 80.03 | 29.23 | 0.77 |
| Reach 1 | 60896 | 580 | 386.5 | 390.8 | 390.8 | 391.95 | 0.019133 | 8.64 | 67.15 | 29.02 | 1 |
| Reach 1 | 60396 | 580 | 379.6 | 384.19 | 382.39 | 384.41 | 0.00252 | 3.82 | 151.78 | 50.57 | 0.39 |
| Reach 1 | 59796 | 580 | 377.4 | 380.38 | 380.33 | 381.13 | 0.018475 | 6.95 | 83.46 | 51.14 | 0.96 |
| Reach 1 | 59500 | 580 | 371.24 | 374.49 | 374.49 | 375.13 | 0.02205 | 6.42 | 90.36 | 70.55 | 1 |
| Reach 1 | 59396 | 580 | 368.2 | 373.25 | 370.67 | 373.33 | 0.000752 | 2.23 | 259.92 | 79.21 | 0.22 |
| Reach 1 | 59300 | 580 | 369.28 | 372.68 | 372.19 | 373.12 | 0.008856 | 5.3 | 109.35 | 57.19 | 0.68 |
| Reach 1 | 59100 | 580 | 367.57 | 372.01 | | 372.21 | 0.002467 | 3.54 | 163.81 | 58.64 | 0.37 |
| Reach 1 | 59096 | 580 | 366.8 | 372.04 | | 372.18 | 0.000938 | 3.02 | 207.26 | 62.95 | 0.25 |
| Reach 1 | 59036 | 580 | 366.52 | 371.81 | 369.67 | 372.08 | 0.00243 | 4.17 | 138.97 | 32.91 | 0.36 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 580 | 366.62 | 369.83 | 369.62 | 370.75 | 0.016054 | 7.73 | 74.99 | 31.59 | 0.88 |
| Reach 1 | 58911 | 580 | 366.29 | 369.02 | | 369.49 | 0.010191 | 5.52 | 105.15 | 58.31 | 0.72 |
| Reach 1 | 58822 | 580 | 365.08 | 367.93 | 367.67 | 368.32 | 0.016794 | 5.04 | 115.11 | 105.79 | 0.85 |
| Reach 1 | 58733 | 580 | 363.34 | 365.91 | 365.91 | 366.59 | 0.022058 | 6.65 | 87.28 | 63.91 | 1 |
| Reach 1 | 58708 | 580 | 353.05 | 353.89 | 355.16 | 363.97 | 1.053229 | 25.47 | 22.77 | 41.16 | 6.04 |
| Reach 1 | 58658 | 580 | 353.45 | 356.96 | 356.51 | 357.6 | 0.010867 | 6.42 | 90.35 | 41.43 | 0.77 |
| Reach 1 | 58608 | 580 | 352.81 | 356.04 | 355.87 | 356.87 | 0.018927 | 7.32 | 79.19 | 45.29 | 0.98 |
| Reach 1 | 58508 | 580 | 351.32 | 355.38 | | 355.77 | 0.005875 | 4.97 | 116.6 | 48.99 | 0.57 |

ExCond (Q=580 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58308 | 580 | 349.09 | 352.69 | 352.61 | 353.81 | 0.017393 | 8.5 | 68.24 | 28.17 | 0.96 |
| Reach 1 | 58108 | 580 | 346.97 | 350.85 | | 351.48 | 0.007476 | 6.37 | 91.09 | 30.38 | 0.65 |
| Reach 1 | 57975 | 580 | 345.1 | 350.34 | | 350.75 | 0.003538 | 5.18 | 112.02 | 25.88 | 0.44 |
| Reach 1 | 57804 | 580 | 343.8 | 349.92 | | 350.08 | 0.003443 | 3.18 | 182.34 | 41.67 | 0.27 |
| Reach 1 | 57619 | 580 | 342.5 | 349.43 | | 349.55 | 0.002266 | 2.75 | 210.66 | 43.26 | 0.22 |
| Reach 1 | 57558 | 580 | 341.78 | 349.15 | | 349.34 | 0.004029 | 3.57 | 162.6 | 33.32 | 0.28 |
| Reach 1 | 57509 | 580 | 341.9 | 349.06 | | 349.17 | 0.001958 | 2.67 | 217.42 | 40.92 | 0.2 |
| Reach 1 | 57388 | 580 | 340.6 | 348.33 | | 348.39 | 0.138037 | 1.97 | 293.88 | 67.79 | 0.17 |
| Reach 1 | 57188 | 580 | 339.1 | 343.76 | | 344.05 | 0.008251 | 4.34 | 133.63 | 37.07 | 0.4 |
| Reach 1 | 57058 | 580 | 337.19 | 342.07 | | 342.56 | 0.015464 | 5.61 | 103.46 | 30.31 | 0.53 |
| Reach 1 | 56979 | 580 | 336.3 | 341.21 | | 341.55 | 0.00922 | 4.66 | 124.36 | 33.05 | 0.42 |
| Reach 1 | 56776 | 580 | 334.1 | 338.95 | | 339.38 | 0.012147 | 5.25 | 110.43 | 29.7 | 0.48 |
| Reach 1 | 56731 | 580 | 334 | 337.91 | 337.18 | 338.97 | 0.002624 | 8.28 | 70.12 | 18 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 580 | 333.3 | 336.48 | 336.48 | 338.09 | 0.005988 | 10.17 | 57.05 | 17.97 | 1.01 |
| Reach 1 | 56670 | 580 | 331.8 | 336.44 | 334.68 | 336.83 | 0.011003 | 5.01 | 115.79 | 31.27 | 0.46 |
| Reach 1 | 56625 | 580 | 330.4 | 336.17 | | 336.43 | 0.005679 | 4.08 | 142.05 | 29.22 | 0.33 |
| Reach 1 | 56596 | 580 | 328.97 | 335.92 | | 336.23 | 0.006558 | 4.47 | 129.78 | 24.18 | 0.34 |
| Reach 1 | 56574 | 580 | 329.8 | 335.66 | | 336.04 | 0.009117 | 4.94 | 117.45 | 26.09 | 0.41 |
| Reach 1 | 56474 | 580 | 329 | 334.66 | | 335.07 | 0.010179 | 5.12 | 113.19 | 26 | 0.43 |
| Reach 1 | 56275 | 580 | 327.3 | 332.77 | | 333.13 | 0.009088 | 4.83 | 120.11 | 27.72 | 0.41 |
| Reach 1 | 56200 | 580 | 326.4 | 332.59 | | 332.71 | 0.00223 | 2.78 | 208.35 | 40.08 | 0.22 |
| Reach 1 | 56100 | 580 | 326 | 332.21 | | 332.4 | 0.003968 | 3.5 | 165.69 | 34.47 | 0.28 |
| Reach 1 | 56074 | 580 | 325.18 | 331.76 | | 332.17 | 0.010243 | 5.19 | 111.65 | 23.75 | 0.42 |
| Reach 1 | 56058 | 580 | 325.18 | 331.52 | | 331.98 | 0.011769 | 5.47 | 106.11 | 23.26 | 0.45 |
| Reach 1 | 56000 | 580 | 325.7 | 330.99 | | 331.34 | 0.008791 | 4.7 | 123.32 | 30.2 | 0.41 |
| Reach 1 | 55902 | 580 | 323.9 | 330.16 | | 330.5 | 0.008226 | 4.74 | 127.44 | 45.65 | 0.39 |
| Reach 1 | 55872 | 580 | 323.8 | 329.82 | | 330.22 | 0.009783 | 5.02 | 115.45 | 27.33 | 0.43 |
| Reach 1 | 55800 | 580 | 323.4 | 329.08 | | 329.48 | 0.010616 | 5.06 | 114.59 | 27.73 | 0.44 |
| Reach 1 | 55706 | 580 | 322.4 | 328.13 | | 328.52 | 0.009764 | 4.97 | 116.6 | 27.97 | 0.43 |
| Reach 1 | 55606 | 580 | 320.3 | 327.47 | | 327.74 | 0.005588 | 4.17 | 139.07 | 27.26 | 0.33 |
| Reach 1 | 55558 | 580 | 321.08 | 326.37 | | 327.12 | 0.021883 | 6.94 | 83.56 | 18.95 | 0.58 |
| Reach 1 | 55505 | 580 | 319.6 | 326.25 | | 326.43 | 0.00375 | 3.48 | 166.8 | 31.41 | 0.27 |
| Reach 1 | 55405 | 580 | 319.1 | 325.44 | | 325.82 | 0.008901 | 4.97 | 116.65 | 23.4 | 0.39 |
| Reach 1 | 55306 | 580 | 318.3 | 324.73 | | 325.02 | 0.006582 | 4.31 | 134.65 | 29.77 | 0.36 |
| Reach 1 | 55206 | 580 | 318 | 324.12 | | 324.37 | 0.006082 | 3.98 | 145.6 | 35.4 | 0.35 |
| Reach 1 | 55108 | 580 | 316.46 | 323.03 | | 323.48 | 0.012448 | 5.41 | 107.14 | 25.32 | 0.46 |
| Reach 1 | 55005 | 580 | 316.1 | 322.21 | | 322.49 | 0.006432 | 4.29 | 142.16 | 72.63 | 0.35 |
| Reach 1 | 54905 | 580 | 315.7 | 321.39 | | 321.7 | 0.009909 | 4.45 | 130.25 | 37.63 | 0.42 |
| Reach 1 | 54805 | 580 | 314.7 | 320.74 | | 320.95 | 0.005209 | 3.78 | 163.74 | 66.66 | 0.31 |
| Reach 1 | 54705 | 580 | 314.5 | 320.4 | | 320.53 | 0.002855 | 2.91 | 199.56 | 45.85 | 0.25 |
| Reach 1 | 54596 | 580 | 313.25 | 319.69 | | 320 | 0.007709 | 4.47 | 129.62 | 30.65 | 0.38 |
| Reach 1 | 54511 | 580 | 312.7 | 319.56 | | 319.68 | 0.003435 | 2.75 | 225.68 | 110.02 | 0.26 |
| Reach 1 | 54496 | 580 | 312.53 | 319.36 | | 319.62 | 0.000245 | 4.1 | 145.87 | 44.14 | 0.33 |
| Reach 1 | 54440 | 580 | 311.9 | 319.19 | | 319.57 | 0.000441 | 5.11 | 203.11 | 220.23 | 0.36 |
| Reach 1 | 54431 | 580 | 311.9 | 318.84 | 315.86 | 319.48 | 0.000838 | 6.44 | 90.09 | 13.06 | 0.43 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 580 | 311.4 | 315.38 | 315.38 | 317.37 | 0.003925 | 11.33 | 51.2 | 12.93 | 1 |
| Reach 1 | 54305 | 580 | 309.9 | 311.61 | 312.74 | 315.53 | 0.361478 | 15.88 | 36.52 | 24.59 | 2.3 |
| Reach 1 | 54296 | 580 | 308.62 | 312.45 | 312.45 | 313.63 | 0.064796 | 8.73 | 66.45 | 28.21 | 1 |

# ExCond (Q=220 cfs)

HEC-RAS Plan: ExCond (Q=220 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 220 | 566 | 569.59 | 569.59 | 570.89 | 0.026976 | 9.15 | 24.05 | 9.39 | 1.01 |
| Reach 1 | 69496 | 220 | 562 | 564.19 | 564.36 | 565.22 | 0.028992 | 8.12 | 27.11 | 17.7 | 1.16 |
| Reach 1 | 69196 | 220 | 558 | 560.01 | 559.8 | 560.46 | 0.014558 | 5.34 | 41.17 | 30.87 | 0.82 |
| Reach 1 | 68696 | 220 | 550 | 551.54 | 551.47 | 552.1 | 0.019316 | 6 | 36.64 | 28.68 | 0.94 |
| Reach 1 | 68396 | 220 | 542 | 545.18 | 545.18 | 545.92 | 0.0219 | 6.88 | 31.98 | 21.84 | 1 |
| Reach 1 | 67796 | 220 | 524 | 526.25 | 526.68 | 527.81 | 0.043695 | 10.05 | 21.9 | 13.49 | 1.39 |
| Reach 1 | 67396 | 220 | 516 | 518.08 | 517.88 | 518.57 | 0.014827 | 5.61 | 39.23 | 27.93 | 0.83 |
| Reach 1 | 66996 | 220 | 508.5 | 510.64 | 510.64 | 511.25 | 0.022993 | 6.28 | 35.01 | 29.36 | 1.01 |
| Reach 1 | 66865 | 220 | 503.7 | 506.45 | 505.53 | 506.81 | 0.006379 | 4.83 | 45.55 | 17.87 | 0.53 |
| Reach 1 | 66850 | 220 | 503 | 506.48 | 505.29 | 506.7 | 0.003532 | 3.74 | 58.76 | 24.97 | 0.43 |
| Reach 1 | 66796 | 220 | 504 | 505.57 | 505.57 | 506.27 | 0.022159 | 6.69 | 32.88 | 23.77 | 1 |
| Reach 1 | 66396 | 220 | 494 | 496.23 | 496.28 | 497.02 | 0.024083 | 7.16 | 30.75 | 21.6 | 1.06 |
| Reach 1 | 66246 | 220 | 488 | 491.59 | 490.93 | 491.95 | 0.008174 | 4.8 | 45.85 | 25.52 | 0.63 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 220 | 488 | 490.81 | 490.81 | 491.57 | 0.02271 | 6.98 | 31.5 | 21.16 | 1.01 |
| Reach 1 | 66096 | 220 | 484.5 | 486.31 | 486.65 | 487.43 | 0.057089 | 8.5 | 25.9 | 27.38 | 1.54 |
| Reach 1 | 65796 | 220 | 476 | 477.61 | 477.61 | 478.25 | 0.022146 | 6.46 | 34.07 | 26.44 | 1 |
| Reach 1 | 65196 | 220 | 466 | 467.75 | 467.39 | 468.07 | 0.010166 | 4.59 | 47.89 | 34.85 | 0.69 |
| Reach 1 | 64596 | 220 | 454 | 457.53 | 457.53 | 458.78 | 0.025735 | 8.98 | 24.49 | 9.88 | 1.01 |
| Reach 1 | 63996 | 220 | 442 | 444.69 | 444.56 | 445.45 | 0.017645 | 6.97 | 31.58 | 17.45 | 0.91 |
| Reach 1 | 63696 | 220 | 436 | 438.74 | 438.74 | 439.59 | 0.021603 | 7.42 | 29.66 | 17.68 | 1.01 |
| Reach 1 | 63620 | 220 | 434.1 | 436.97 | 435.92 | 437.23 | 0.004501 | 4.13 | 53.31 | 22.62 | 0.47 |
| Reach 1 | 63596 | 220 | 433.7 | 436.97 | | 437.12 | 0.002358 | 3.07 | 71.61 | 28.96 | 0.34 |
| Reach 1 | 63396 | 220 | 432 | 434.87 | 434.87 | 435.94 | 0.023513 | 8.32 | 26.44 | 12.45 | 1.01 |
| Reach 1 | 62796 | 220 | 416.47 | 418.95 | 419.1 | 419.96 | 0.03034 | 8.05 | 27.31 | 17.62 | 1.14 |
| Reach 1 | 62690 | 220 | 415.18 | 417.08 | 416.84 | 417.68 | 0.015729 | 6.22 | 35.37 | 19.56 | 0.82 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 220 | 414.14 | 416.14 | 416.14 | 416.93 | 0.025673 | 7.13 | 30.87 | 19.95 | 1.01 |
| Reach 1 | 62631 | 220 | 411.86 | 413.88 | 414.42 | 415.55 | 0.080265 | 10.37 | 21.21 | 21.29 | 1.83 |
| Reach 1 | 62596 | 220 | 411 | 413.05 | 413.12 | 413.77 | 0.026633 | 6.82 | 32.24 | 26.38 | 1.09 |
| Reach 1 | 62096 | 220 | 404 | 405.98 | 405.67 | 406.24 | 0.010978 | 4.17 | 52.81 | 47.48 | 0.7 |
| Reach 1 | 61696 | 220 | 398 | 400.3 | 400.1 | 400.85 | 0.016746 | 5.97 | 36.83 | 25.73 | 0.88 |
| Reach 1 | 61396 | 220 | 394 | 396.67 | 396.16 | 397.11 | 0.009473 | 5.34 | 41.22 | 21.9 | 0.69 |
| Reach 1 | 60896 | 220 | 386.5 | 389.45 | 389.45 | 390.18 | 0.021972 | 6.87 | 32 | 21.85 | 1 |
| Reach 1 | 60396 | 220 | 379.6 | 382.63 | 381.26 | 382.74 | 0.002009 | 2.69 | 81.88 | 39.21 | 0.33 |
| Reach 1 | 59796 | 220 | 377.4 | 379.48 | 379.41 | 379.93 | 0.020145 | 5.35 | 41.1 | 39.94 | 0.93 |
| Reach 1 | 59500 | 220 | 371.24 | 372.97 | 372.97 | 373.64 | 0.022216 | 6.56 | 33.54 | 25.34 | 1 |
| Reach 1 | 59396 | 220 | 368.2 | 372.09 | 369.9 | 372.12 | 0.000345 | 1.26 | 174.06 | 69.54 | 0.14 |
| Reach 1 | 59300 | 220 | 369.28 | 371.85 | 371.05 | 372.02 | 0.004692 | 3.32 | 66.22 | 43.32 | 0.47 |
| Reach 1 | 59100 | 220 | 367.57 | 369.63 | 369.63 | 370.15 | 0.025384 | 5.78 | 38.04 | 38.11 | 1.02 |
| Reach 1 | 59096 | 220 | 366.8 | 369.63 | 368.3 | 369.74 | 0.001833 | 2.59 | 84.95 | 39.98 | 0.31 |
| Reach 1 | 59036 | 220 | 366.52 | 369.34 | 368.61 | 369.55 | 0.00512 | 3.74 | 58.84 | 31.84 | 0.48 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 220 | 366.62 | 368.93 | 368.57 | 369.27 | 0.010335 | 4.7 | 46.8 | 31.11 | 0.68 |
| Reach 1 | 58911 | 220 | 366.29 | 368.16 | | 368.39 | 0.008769 | 3.8 | 57.88 | 50.25 | 0.62 |
| Reach 1 | 58822 | 220 | 365.08 | 367.11 | 366.98 | 367.37 | 0.015214 | 4.11 | 53.56 | 62.1 | 0.78 |
| Reach 1 | 58733 | 220 | 363.34 | 365.25 | 365.25 | 365.61 | 0.026412 | 4.81 | 45.72 | 62.98 | 1 |
| Reach 1 | 58708 | 220 | 353.05 | 356.08 | 354.29 | 356.14 | 0.000832 | 1.95 | 112.92 | 41.39 | 0.21 |
| Reach 1 | 58658 | 220 | 353.45 | 355.55 | | 355.99 | 0.012726 | 5.36 | 41.06 | 27.87 | 0.78 |
| Reach 1 | 58608 | 220 | 352.81 | 354.94 | | 355.35 | 0.0121 | 5.18 | 42.43 | 29.17 | 0.76 |
| Reach 1 | 58508 | 220 | 351.32 | 353.82 | | 354.15 | 0.011345 | 4.59 | 47.91 | 37.41 | 0.72 |
| Reach 1 | 58308 | 220 | 349.09 | 351.74 | 351.22 | 352.14 | 0.008869 | 5.06 | 43.49 | 23.85 | 0.66 |
| Reach 1 | 58108 | 220 | 346.97 | 348.78 | 348.78 | 349.45 | 0.02203 | 6.6 | 33.31 | 24.86 | 1.01 |
| Reach 1 | 57975 | 220 | 345.1 | 347.87 | 346.8 | 348.13 | 0.004248 | 4.08 | 53.91 | 21.89 | 0.46 |
| Reach 1 | 57804 | 220 | 343.8 | 347.26 | | 347.36 | 0.00419 | 2.58 | 85.16 | 31.33 | 0.28 |
| Reach 1 | 57619 | 220 | 342.5 | 346.74 | | 346.81 | 0.002113 | 2.04 | 107.72 | 33.39 | 0.2 |
| Reach 1 | 57558 | 220 | 341.78 | 346.54 | | 346.64 | 0.003314 | 2.57 | 85.77 | 25.4 | 0.25 |
| Reach 1 | 57509 | 220 | 341.9 | 346.46 | | 346.51 | 0.001473 | 1.82 | 120.92 | 33.37 | 0.17 |
| Reach 1 | 57388 | 220 | 340.6 | 345.94 | | 345.97 | 0.061438 | 1.34 | 164.18 | 35.55 | 0.11 |

## ExCond (Q=220 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 57188 | 220 | 339.1 | 341.74 | | 341.91 | 0.009831 | 3.38 | 65.07 | 30.63 | 0.41 |
| Reach 1 | 57058 | 220 | 337.19 | 340.05 | | 340.33 | 0.014794 | 4.3 | 51.19 | 21.69 | 0.49 |
| Reach 1 | 56979 | 220 | 336.3 | 339.22 | 337.9 | 339.4 | 0.008559 | 3.4 | 64.79 | 26.79 | 0.38 |
| Reach 1 | 56776 | 220 | 334.1 | 336.63 | | 336.94 | 0.017674 | 4.47 | 49.22 | 23.05 | 0.54 |
| Reach 1 | 56731 | 220 | 334 | 336.04 | 335.67 | 336.6 | 0.002919 | 6.01 | 36.6 | 17.95 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 220 | 333.3 | 334.97 | 334.97 | 335.81 | 0.006224 | 7.36 | 29.89 | 17.94 | 1 |
| Reach 1 | 56670 | 220 | 331.8 | 332.79 | 333.36 | 334.73 | 0.321584 | 11.19 | 19.66 | 21.29 | 2.05 |
| Reach 1 | 56625 | 220 | 330.4 | 333.62 | 331.92 | 333.77 | 0.00575 | 3.02 | 72.79 | 25.15 | 0.31 |
| Reach 1 | 56596 | 220 | 328.97 | 333.48 | | 333.62 | 0.004426 | 2.94 | 74.93 | 20.8 | 0.27 |
| Reach 1 | 56574 | 220 | 329.8 | 333.26 | | 333.46 | 0.00841 | 3.62 | 60.78 | 21.14 | 0.38 |
| Reach 1 | 56474 | 220 | 329 | 332.39 | 330.87 | 332.6 | 0.008901 | 3.68 | 59.73 | 21.19 | 0.39 |
| Reach 1 | 56275 | 220 | 327.3 | 330.18 | | 330.44 | 0.013453 | 4.06 | 54.25 | 23.16 | 0.47 |
| Reach 1 | 56200 | 220 | 326.4 | 329.95 | | 330.01 | 0.002161 | 2.01 | 109.34 | 34.8 | 0.2 |
| Reach 1 | 56100 | 220 | 326 | 329.61 | | 329.71 | 0.003886 | 2.6 | 84.53 | 27.95 | 0.26 |
| Reach 1 | 56074 | 220 | 325.18 | 329.34 | | 329.54 | 0.008081 | 3.65 | 60.23 | 18.75 | 0.36 |
| Reach 1 | 56058 | 220 | 325.18 | 329.16 | | 329.39 | 0.00942 | 3.86 | 57.02 | 18.4 | 0.39 |
| Reach 1 | 56000 | 220 | 325.7 | 328.59 | | 328.81 | 0.01075 | 3.77 | 58.31 | 23.94 | 0.43 |
| Reach 1 | 55902 | 220 | 323.9 | 327.75 | | 327.94 | 0.007229 | 3.47 | 63.43 | 20.8 | 0.35 |
| Reach 1 | 55872 | 220 | 323.8 | 327.46 | | 327.68 | 0.009534 | 3.79 | 58 | 21.18 | 0.4 |
| Reach 1 | 55800 | 220 | 323.4 | 326.7 | | 326.94 | 0.011173 | 3.93 | 56 | 21.38 | 0.43 |
| Reach 1 | 55706 | 220 | 322.4 | 325.42 | | 325.72 | 0.014567 | 4.35 | 50.55 | 20.75 | 0.49 |
| Reach 1 | 55606 | 220 | 320.3 | 324.7 | | 324.85 | 0.005005 | 3.07 | 71.75 | 21.43 | 0.3 |
| Reach 1 | 55558 | 220 | 321.08 | 323.72 | | 324.25 | 0.030786 | 5.84 | 37.68 | 15.69 | 0.66 |
| Reach 1 | 55505 | 220 | 319.6 | 323.53 | | 323.62 | 0.003395 | 2.5 | 87.9 | 26.61 | 0.24 |
| Reach 1 | 55405 | 220 | 319.1 | 322.92 | | 323.11 | 0.007299 | 3.51 | 62.69 | 19.43 | 0.34 |
| Reach 1 | 55306 | 220 | 318.3 | 322.3 | | 322.45 | 0.00577 | 3.14 | 70.14 | 23.22 | 0.32 |
| Reach 1 | 55206 | 220 | 318 | 321.57 | | 321.75 | 0.008538 | 3.4 | 64.76 | 26.46 | 0.38 |
| Reach 1 | 55108 | 220 | 316.46 | 320.48 | | 320.75 | 0.011789 | 4.16 | 52.91 | 17.94 | 0.43 |
| Reach 1 | 55005 | 220 | 316.1 | 319.58 | | 319.76 | 0.007482 | 3.4 | 64.62 | 23.25 | 0.36 |
| Reach 1 | 54905 | 220 | 315.7 | 318.73 | | 318.93 | 0.009 | 3.6 | 61.15 | 22.93 | 0.39 |
| Reach 1 | 54805 | 220 | 314.7 | 318.08 | | 318.22 | 0.005367 | 2.96 | 74.27 | 24.92 | 0.3 |
| Reach 1 | 54705 | 220 | 314.5 | 317.61 | | 317.71 | 0.004431 | 2.53 | 87.02 | 34.9 | 0.28 |
| Reach 1 | 54596 | 220 | 313.25 | 316.46 | | 316.79 | 0.017346 | 4.61 | 47.68 | 20.17 | 0.53 |
| Reach 1 | 54511 | 220 | 312.7 | 315.48 | | 315.85 | 0.025098 | 4.9 | 44.89 | 24.21 | 0.63 |
| Reach 1 | 54496 | 220 | 312.53 | 314.74 | 314.74 | 315.61 | 0.003058 | 7.45 | 29.54 | 17.38 | 1.01 |
| Reach 1 | 54440 | 220 | 311.9 | 314.46 | 314.06 | 315.16 | 0.001998 | 6.74 | 32.65 | 13.78 | 0.77 |
| Reach 1 | 54431 | 220 | 311.9 | 314.44 | 313.98 | 315.14 | 0.002051 | 6.7 | 32.82 | 12.96 | 0.74 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 220 | 311.4 | 313.48 | 313.48 | 314.53 | 0.003758 | 8.23 | 26.75 | 12.87 | 1.01 |
| Reach 1 | 54305 | 220 | 309.9 | 310.84 | 311.46 | 313.01 | 0.408111 | 11.8 | 18.64 | 22.04 | 2.26 |
| Reach 1 | 54296 | 220 | 308.62 | 311.19 | 311.19 | 311.87 | 0.074518 | 6.62 | 33.22 | 24.45 | 1 |

# Alt. 2 (Q = 1180 cfs)

HEC-RAS Plan: Alt.1 (Q = 1180 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach 1 | 69696 | 1180 | 566 | 573.82 | 573.88 | 575.56 | 0.020001 | 10.58 | 111.54 | 33.7 | 1.02 |
| Reach 1 | 69496 | 1180 | 562 | 566.51 | 567.52 | 569.79 | 0.042289 | 14.53 | 81.2 | 29 | 1.53 |
| Reach 1 | 69196 | 1180 | 558 | 562.31 | 562.22 | 563.62 | 0.015854 | 9.17 | 128.68 | 45.15 | 0.96 |
| Reach 1 | 68696 | 1180 | 550 | 553.92 | 553.92 | 555.27 | 0.017596 | 9.32 | 126.64 | 47.55 | 1.01 |
| Reach 1 | 68396 | 1180 | 542 | 547.73 | 547.95 | 549.37 | 0.021868 | 10.29 | 114.65 | 43.07 | 1.11 |
| Reach 1 | 67796 | 1180 | 524 | 529.41 | 530.48 | 532.68 | 0.035765 | 14.51 | 81.32 | 24.05 | 1.39 |
| Reach 1 | 67396 | 1180 | 516 | 520.24 | 520.35 | 521.6 | 0.020131 | 9.34 | 126.32 | 52.64 | 1.06 |
| Reach 1 | 66996 | 1180 | 508.5 | 513.02 | 513.02 | 514.32 | 0.017431 | 9.17 | 128.71 | 49.36 | 1 |
| Reach 1 | 66865 | 1180 | 503.7 | 508.85 | 509.06 | 511.49 | 0.024842 | 13.03 | 90.59 | 19.65 | 1.07 |
| Reach 1 | 66850 | 1180 | 503 | 509.8 | 508.32 | 510.65 | 0.006115 | 7.38 | 159.96 | 36 | 0.62 |
| Reach 1 | 66796 | 1180 | 504 | 508.36 | 508.36 | 510.04 | 0.017439 | 10.42 | 113.23 | 33.98 | 1.01 |
| Reach 1 | 66396 | 1180 | 494 | 498.47 | 499.1 | 500.78 | 0.031708 | 12.21 | 96.65 | 37.27 | 1.34 |
| Reach 1 | 66246 | 1180 | 488 | 496.41 | 493.83 | 496.71 | 0.002316 | 4.41 | 267.39 | 66.47 | 0.39 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 1180 | 488 | 493.53 | 493.53 | 494.8 | 0.018085 | 9.04 | 130.57 | 51.74 | 1 |
| Reach 1 | 66096 | 1180 | 484.5 | 487.92 | 488.91 | 490.95 | 0.062395 | 13.97 | 84.49 | 45.15 | 1.8 |
| Reach 1 | 65796 | 1180 | 476 | 480.14 | 480.14 | 481.59 | 0.017439 | 9.68 | 121.91 | 42.53 | 1.01 |
| Reach 1 | 65196 | 1180 | 466 | 470.71 | 469.65 | 471.32 | 0.006468 | 6.24 | 189.13 | 61.55 | 0.63 |
| Reach 1 | 64596 | 1180 | 454 | 462.43 | 462.43 | 464.71 | 0.021214 | 12.11 | 97.48 | 21.78 | 1.01 |
| Reach 1 | 63996 | 1180 | 442 | 447.28 | 447.92 | 449.89 | 0.029213 | 12.97 | 90.98 | 28.45 | 1.28 |
| Reach 1 | 63696 | 1180 | 436 | 441.98 | 441.98 | 443.74 | 0.017082 | 10.65 | 110.83 | 31.51 | 1 |
| Reach 1 | 63620 | 1180 | 434.1 | 441.96 | 439.05 | 442.55 | 0.003268 | 6.17 | 191.27 | 30.55 | 0.43 |
| Reach 1 | 63596 | 1180 | 433.7 | 442.02 | | 442.43 | 0.002105 | 5.14 | 229.74 | 33.71 | 0.35 |
| Reach 1 | 63396 | 1180 | 432 | 439.02 | 439.02 | 441.29 | 0.020075 | 12.1 | 97.54 | 21.79 | 1.01 |
| Reach 1 | 62796 | 1180 | 416.47 | 421.75 | 422.66 | 425.18 | 0.037094 | 14.86 | 79.41 | 20.68 | 1.34 |
| Reach 1 | 62690 | 1180 | 415.18 | 420.52 | 420.11 | 422.57 | 0.018313 | 11.48 | 102.82 | 19.65 | 0.88 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 1180 | 414.14 | 419.37 | 419.37 | 421.73 | 0.023588 | 12.35 | 95.57 | 20.19 | 1 |
| Reach 1 | 62631 | 1180 | 411.86 | 415.5 | 416.86 | 420.22 | 0.089783 | 17.43 | 67.71 | 33.43 | 2.16 |
| Reach 1 | 62596 | 1180 | 411 | 414.77 | 415.57 | 417.56 | 0.042249 | 13.4 | 88.07 | 36.31 | 1.52 |
| Reach 1 | 62096 | 1180 | 404 | 407.56 | 407.49 | 408.43 | 0.01786 | 7.45 | 158.38 | 85.52 | 0.96 |
| Reach 1 | 61696 | 1180 | 398 | 403.24 | | 403.86 | 0.007704 | 6.32 | 186.67 | 67.65 | 0.67 |
| Reach 1 | 61396 | 1180 | 394 | 399.75 | | 401 | 0.011555 | 8.96 | 131.63 | 36.79 | 0.84 |
| Reach 1 | 60896 | 1180 | 386.5 | 392.27 | 392.27 | 393.93 | 0.017445 | 10.33 | 114.22 | 34.64 | 1 |
| Reach 1 | 60396 | 1180 | 375 | 381.36 | 380.37 | 382.21 | 0.007585 | 7.4 | 159.53 | 44.15 | 0.69 |
| Reach 1 | 59796 | 1180 | 367.19 | 374.95 | 374.44 | 376.39 | 0.012561 | 9.62 | 122.61 | 30.8 | 0.85 |
| Reach 1 | 59500 | 1180 | 363.34 | 369.72 | 369.72 | 371.85 | 0.018556 | 11.7 | 100.81 | 23.76 | 1 |
| Reach 1 | 59396 | 1180 | 362 | 368.88 | 366.93 | 369.25 | 0.002909 | 4.86 | 242.57 | 62.42 | 0.43 |
| Reach 1 | 59300 | 1180 | 360.74 | 366.93 | 366.93 | 368.57 | 0.017187 | 10.28 | 114.81 | 35.19 | 1 |
| Reach 1 | 59100 | 1180 | 358.14 | 365.82 | 362.94 | 366.17 | 0.002013 | 4.71 | 250.63 | 49.45 | 0.37 |
| Reach 1 | 59096 | 1180 | 358.09 | 364.68 | | 366.05 | 0.010101 | 9.38 | 125.81 | 26.29 | 0.76 |
| Reach 1 | 59036 | 1180 | 357.31 | 364.29 | 362.98 | 365.44 | 0.007914 | 8.6 | 137.18 | 26.86 | 0.67 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 1180 | 356.85 | 362.86 | 362.86 | 364.99 | 0.018466 | 11.71 | 100.78 | 23.99 | 1.01 |
| Reach 1 | 58911 | 1180 | 355.69 | 359.3 | 360.22 | 362.3 | 0.053099 | 13.91 | 84.84 | 40.08 | 1.68 |
| Reach 1 | 58822 | 1180 | 354.53 | 358.92 | 358.71 | 360.19 | 0.013961 | 9.05 | 130.38 | 42.39 | 0.91 |
| Reach 1 | 58733 | 1180 | 353.38 | 359.27 | | 359.54 | 0.001789 | 4.2 | 280.9 | 60.21 | 0.34 |
| Reach 1 | 58708 | 1180 | 353.05 | 359.11 | | 359.48 | 0.002322 | 4.94 | 240.41 | 44.29 | 0.36 |
| Reach 1 | 58658 | 1180 | 353.45 | 357.91 | 357.76 | 359.16 | 0.014669 | 8.96 | 131.72 | 45.52 | 0.93 |
| Reach 1 | 58608 | 1180 | 352.81 | 357.35 | | 358.39 | 0.013487 | 8.19 | 144.12 | 53.86 | 0.88 |
| Reach 1 | 58508 | 1180 | 351.32 | 356.9 | | 357.47 | 0.005066 | 6.06 | 194.56 | 53.51 | 0.56 |
| Reach 1 | 58308 | 1180 | 349.09 | 354.52 | 354.14 | 355.87 | 0.012646 | 9.31 | 126.78 | 35.35 | 0.87 |
| Reach 1 | 58108 | 1180 | 346.97 | 353.5 | | 354.12 | 0.005145 | 6.32 | 186.66 | 47.3 | 0.56 |
| Reach 1 | 57975 | 1180 | 345.1 | 352.96 | | 353.53 | 0.003675 | 6.07 | 194.36 | 37.02 | 0.47 |
| Reach 1 | 57804 | 1180 | 343.8 | 352.59 | | 352.82 | 0.003416 | 3.83 | 307.8 | 52.38 | 0.28 |
| Reach 1 | 57619 | 1180 | 342.5 | 352.06 | | 352.25 | 0.002592 | 3.5 | 337.22 | 52.94 | 0.24 |
| Reach 1 | 57558 | 1180 | 341.78 | 351.67 | | 352 | 0.004874 | 4.62 | 255.61 | 40.4 | 0.32 |
| Reach 1 | 57509 | 1180 | 341.9 | 351.56 | | 351.76 | 0.002581 | 3.59 | 329.1 | 48.2 | 0.24 |

## Alt. 2 (Q = 1180 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 57388 | 1180 | 340.6 | 350.63 | | 350.73 | 0.152537 | 2.56 | 461.38 | 77.46 | 0.18 |
| Reach 1 | 57188 | 1180 | 339.1 | 345.98 | | 346.41 | 0.007988 | 5.24 | 225.07 | 45.35 | 0.41 |
| Reach 1 | 57058 | 1180 | 337.19 | 344.42 | | 345.04 | 0.012989 | 6.33 | 186.47 | 39.84 | 0.52 |
| Reach 1 | 56979 | 1180 | 336.3 | 343.69 | | 344.16 | 0.008207 | 5.46 | 216.16 | 40.87 | 0.42 |
| Reach 1 | 56776 | 1180 | 334.1 | 342.09 | | 342.54 | 0.007718 | 5.43 | 217.47 | 38.66 | 0.4 |
| Reach 1 | 56731 | 1180 | 334 | 339.38 | 339.12 | 341.69 | 0.005336 | 12.21 | 96.67 | 18.03 | 0.93 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 1180 | 333.3 | 338.42 | 338.42 | 340.98 | 0.006143 | 12.83 | 92.01 | 18.02 | 1 |
| Reach 1 | 56670 | 1180 | 331.8 | 339.22 | 336.25 | 339.7 | 0.008226 | 5.54 | 213.15 | 38.85 | 0.42 |
| Reach 1 | 56625 | 1180 | 330.4 | 338.93 | | 339.35 | 0.00614 | 5.16 | 228.85 | 33.64 | 0.35 |
| Reach 1 | 56596 | 1180 | 328.97 | 338.54 | | 339.1 | 0.008542 | 5.96 | 197.95 | 27.81 | 0.39 |
| Reach 1 | 56574 | 1180 | 329.8 | 338.32 | | 338.89 | 0.009497 | 6.08 | 194.14 | 31.58 | 0.43 |
| Reach 1 | 56474 | 1180 | 329 | 337.29 | | 337.9 | 0.010308 | 6.25 | 188.92 | 31.57 | 0.45 |
| Reach 1 | 56275 | 1180 | 327.3 | 335.41 | | 335.95 | 0.009027 | 5.92 | 199.33 | 32.37 | 0.42 |
| Reach 1 | 56200 | 1180 | 326.4 | 335.24 | | 335.45 | 0.002662 | 3.67 | 324.62 | 61.6 | 0.24 |
| Reach 1 | 56100 | 1180 | 326 | 334.93 | | 335.14 | 0.003416 | 3.91 | 331.78 | 98.51 | 0.27 |
| Reach 1 | 56074 | 1180 | 325.18 | 334.13 | | 334.84 | 0.012385 | 6.78 | 175.45 | 34.59 | 0.48 |
| Reach 1 | 56058 | 1180 | 325.18 | 333.8 | | 334.6 | 0.01463 | 7.17 | 164.83 | 30.37 | 0.52 |
| Reach 1 | 56000 | 1180 | 325.7 | 333.44 | | 333.82 | 0.007062 | 5.13 | 275.37 | 167.57 | 0.38 |
| Reach 1 | 55902 | 1180 | 323.9 | 333.02 | | 333.2 | 0.004139 | 3.8 | 375.19 | 180.06 | 0.29 |
| Reach 1 | 55872 | 1180 | 323.8 | 332.28 | | 332.87 | 0.010699 | 6.2 | 190.37 | 34.62 | 0.47 |
| Reach 1 | 55800 | 1180 | 323.4 | 331.53 | | 332.1 | 0.010709 | 6.1 | 205.28 | 100.42 | 0.46 |
| Reach 1 | 55706 | 1180 | 322.4 | 330.79 | | 331.19 | 0.007264 | 5.29 | 261.37 | 139.16 | 0.39 |
| Reach 1 | 55606 | 1180 | 320.3 | 330.34 | | 330.58 | 0.004134 | 4.22 | 332.21 | 147.79 | 0.29 |
| Reach 1 | 55558 | 1180 | 321.08 | 328.53 | | 329.85 | 0.025807 | 9.23 | 129.63 | 25.95 | 0.65 |
| Reach 1 | 55505 | 1180 | 319.6 | 328.62 | | 328.87 | 0.00399 | 4.18 | 314.68 | 97.84 | 0.28 |
| Reach 1 | 55405 | 1180 | 319.1 | 327.68 | | 328.19 | 0.009961 | 6 | 220.81 | 82.17 | 0.42 |
| Reach 1 | 55306 | 1180 | 318.3 | 326.9 | | 327.21 | 0.008021 | 4.75 | 274.96 | 115.81 | 0.4 |
| Reach 1 | 55206 | 1180 | 318 | 326.33 | | 326.53 | 0.005105 | 3.84 | 330.61 | 119.57 | 0.32 |
| Reach 1 | 55108 | 1180 | 316.46 | 324.58 | | 325.45 | 0.01945 | 7.6 | 162.03 | 43.76 | 0.6 |
| Reach 1 | 55005 | 1180 | 316.1 | 323.98 | | 324.19 | 0.005261 | 3.93 | 324.79 | 125.54 | 0.32 |
| Reach 1 | 54905 | 1180 | 315.7 | 323.39 | | 323.6 | 0.006511 | 3.93 | 327.84 | 148.16 | 0.35 |
| Reach 1 | 54805 | 1180 | 314.7 | 323.02 | | 323.13 | 0.002954 | 2.62 | 443.2 | 159.29 | 0.24 |
| Reach 1 | 54705 | 1180 | 314.5 | 322.85 | | 322.93 | 0.001315 | 2.53 | 563.31 | 240 | 0.18 |
| Reach 1 | 54596 | 1180 | 313.25 | 322.16 | | 322.56 | 0.00605 | 5.26 | 241.06 | 58.91 | 0.36 |
| Reach 1 | 54511 | 1180 | 312.7 | 322.27 | | 322.31 | 0.000689 | 1.72 | 745.48 | 215 | 0.13 |
| Reach 1 | 54496 | 1180 | 312.53 | 321.9 | | 322.22 | 0.000195 | 4.84 | 403.37 | 105.45 | 0.31 |
| Reach 1 | 54440 | 1180 | 311.9 | 322.01 | | 322.1 | 0.000126 | 3.49 | 1084.65 | 400 | 0.2 |
| Reach 1 | 54431 | 1180 | 311.9 | 322.02 | 318.28 | 322.07 | 0.000126 | 2.97 | 1522.92 | 790 | 0.17 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 1180 | 311.4 | 317.78 | 317.78 | 320.97 | 0.004401 | 14.33 | 82.33 | 13.02 | 1 |
| Reach 1 | 54305 | 1180 | 309.9 | 312.48 | 314.31 | 318.63 | 0.35638 | 19.9 | 59.29 | 27.5 | 2.39 |
| Reach 1 | 54296 | 1180 | 308.62 | 313.97 | 313.97 | 315.65 | 0.059007 | 10.4 | 113.45 | 33.79 | 1 |

## Alt. 2 (Q = 580 cfs)

HEC-RAS Plan: Alt.1 (Q = 580 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 580 | 566 | 572.05 | 572.05 | 573.43 | 0.021958 | 9.42 | 61.56 | 22.72 | 1.01 |
| Reach 1 | 69496 | 580 | 562 | 565.25 | 565.9 | 567.47 | 0.041143 | 11.96 | 48.5 | 22.84 | 1.45 |
| Reach 1 | 69196 | 580 | 558 | 561.16 | 560.93 | 561.96 | 0.014354 | 7.19 | 80.61 | 37.98 | 0.87 |
| Reach 1 | 68696 | 580 | 550 | 552.64 | 552.64 | 553.63 | 0.019423 | 8 | 72.52 | 36.91 | 1.01 |
| Reach 1 | 68396 | 580 | 542 | 546.52 | 546.57 | 547.63 | 0.020614 | 8.46 | 68.54 | 32.96 | 1.03 |
| Reach 1 | 67796 | 580 | 524 | 527.7 | 528.46 | 530.28 | 0.042543 | 12.89 | 45 | 18.33 | 1.45 |
| Reach 1 | 67396 | 580 | 516 | 519.21 | 519.11 | 520.07 | 0.017359 | 7.44 | 77.92 | 40.87 | 0.95 |
| Reach 1 | 66996 | 580 | 508.5 | 511.78 | 511.78 | 512.73 | 0.019305 | 7.83 | 74.07 | 38.96 | 1 |
| Reach 1 | 66865 | 580 | 503.7 | 506.47 | 507.11 | 508.95 | 0.043233 | 12.63 | 45.94 | 17.88 | 1.39 |
| Reach 1 | 66850 | 580 | 503 | 508.09 | 506.69 | 508.58 | 0.004974 | 5.62 | 103.22 | 30.32 | 0.54 |
| Reach 1 | 66796 | 580 | 504 | 506.86 | 506.86 | 508.04 | 0.019262 | 8.73 | 66.47 | 28.49 | 1.01 |
| Reach 1 | 66396 | 580 | 494 | 497.36 | 497.67 | 498.83 | 0.027894 | 9.71 | 59.72 | 29.53 | 1.2 |
| Reach 1 | 66246 | 580 | 488 | 491.83 | 492.39 | 493.75 | 0.04103 | 11.14 | 52.06 | 27.51 | 1.43 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 580 | 488 | 492.22 | 492.23 | 493.22 | 0.02027 | 8.03 | 72.25 | 36.94 | 1.01 |
| Reach 1 | 66096 | 580 | 484.5 | 487.07 | 487.73 | 489.15 | 0.063085 | 11.58 | 50.09 | 35.81 | 1.73 |
| Reach 1 | 65796 | 580 | 476 | 478.82 | 478.82 | 479.86 | 0.019208 | 8.19 | 70.8 | 34.3 | 1 |
| Reach 1 | 65196 | 580 | 466 | 469.12 | 468.46 | 469.61 | 0.007924 | 5.59 | 103.82 | 46.53 | 0.66 |
| Reach 1 | 64596 | 580 | 454 | 459.86 | 459.86 | 461.79 | 0.024026 | 11.14 | 52.04 | 13.77 | 1.01 |
| Reach 1 | 63996 | 580 | 442 | 446.02 | 446.2 | 447.55 | 0.023071 | 9.91 | 58.55 | 23.1 | 1.1 |
| Reach 1 | 63696 | 580 | 436 | 440.33 | 440.33 | 441.6 | 0.018713 | 9.05 | 64.09 | 25.25 | 1 |
| Reach 1 | 63620 | 580 | 434.1 | 439.33 | 437.37 | 439.73 | 0.003625 | 5.12 | 113.39 | 28.38 | 0.45 |
| Reach 1 | 63596 | 580 | 433.7 | 439.37 | | 439.62 | 0.00199 | 4.04 | 143.64 | 31.21 | 0.33 |
| Reach 1 | 63396 | 580 | 432 | 436.87 | 436.87 | 438.54 | 0.021511 | 10.38 | 55.89 | 16.96 | 1.01 |
| Reach 1 | 62796 | 580 | 416.47 | 420.18 | 420.65 | 422.33 | 0.034656 | 11.77 | 49.29 | 18.12 | 1.26 |
| Reach 1 | 62690 | 580 | 415.18 | 418.66 | 418.27 | 419.85 | 0.015923 | 8.74 | 66.39 | 19.6 | 0.84 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 580 | 414.14 | 417.57 | 417.57 | 419.05 | 0.02347 | 9.77 | 59.39 | 20.06 | 1 |
| Reach 1 | 62631 | 580 | 411.86 | 414.7 | 415.57 | 417.64 | 0.086528 | 13.77 | 42.11 | 29.19 | 2.02 |
| Reach 1 | 62596 | 580 | 411 | 413.96 | 414.3 | 415.43 | 0.033175 | 9.71 | 59.75 | 33.7 | 1.28 |
| Reach 1 | 62096 | 580 | 404 | 406.85 | 406.58 | 407.34 | 0.013307 | 5.62 | 103.22 | 68.31 | 0.81 |
| Reach 1 | 61696 | 580 | 398 | 401.84 | | 402.37 | 0.011577 | 5.83 | 99.53 | 55.41 | 0.77 |
| Reach 1 | 61396 | 580 | 394 | 398.19 | | 399 | 0.010719 | 7.25 | 80.03 | 29.23 | 0.77 |
| Reach 1 | 60896 | 580 | 386.5 | 390.8 | 390.8 | 391.95 | 0.019133 | 8.64 | 67.15 | 29.02 | 1 |
| Reach 1 | 60396 | 580 | 379.6 | 384.19 | 382.39 | 384.41 | 0.00252 | 3.82 | 151.78 | 50.57 | 0.39 |
| Reach 1 | 59796 | 580 | 377.4 | 380.38 | 380.33 | 381.13 | 0.018473 | 6.95 | 83.47 | 51.14 | 0.96 |
| Reach 1 | 59500 | 580 | 371.24 | 374.49 | 374.49 | 375.13 | 0.022054 | 6.42 | 90.35 | 70.54 | 1 |
| Reach 1 | 59396 | 580 | 368.2 | 370.28 | 370.69 | 371.65 | 0.053944 | 9.38 | 61.84 | 54.37 | 1.55 |
| Reach 1 | 59300 | 580 | 365 | 368.42 | 368.42 | 369.43 | 0.019089 | 8.05 | 72.03 | 35.88 | 1 |
| Reach 1 | 59100 | 580 | 360.8 | 365.65 | 363.79 | 365.86 | 0.002122 | 3.69 | 157.05 | 47.96 | 0.36 |
| Reach 1 | 59096 | 580 | 360.8 | 364.39 | 364.39 | 365.72 | 0.019344 | 9.28 | 62.51 | 23.7 | 1.01 |
| Reach 1 | 59036 | 580 | 359.6 | 363.56 | 363.14 | 364.49 | 0.011871 | 7.73 | 75.08 | 26 | 0.8 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 580 | 359.5 | 362.54 | 362.54 | 363.89 | 0.026123 | 8.8 | 62.32 | 23.38 | 1.12 |
| Reach 1 | 58911 | 580 | 357.1 | 359.34 | 359.77 | 360.89 | 0.04429 | 10.02 | 57.89 | 39.39 | 1.46 |
| Reach 1 | 58822 | 580 | 355.5 | 357.88 | 357.88 | 358.85 | 0.019752 | 7.9 | 73.39 | 38.42 | 1.01 |
| Reach 1 | 58733 | 580 | 353.5 | 357.7 | 355.72 | 357.84 | 0.001523 | 3.07 | 188.89 | 59.49 | 0.3 |
| Reach 1 | 58708 | 580 | 353.05 | 357.64 | | 357.8 | 0.001394 | 3.27 | 177.64 | 41.55 | 0.28 |
| Reach 1 | 58658 | 580 | 353.45 | 356.96 | | 357.6 | 0.010867 | 6.42 | 90.35 | 41.43 | 0.77 |
| Reach 1 | 58608 | 580 | 352.81 | 356.04 | 355.87 | 356.87 | 0.018927 | 7.32 | 79.19 | 45.29 | 0.98 |
| Reach 1 | 58508 | 580 | 351.32 | 355.38 | | 355.77 | 0.005875 | 4.97 | 116.6 | 48.99 | 0.57 |
| Reach 1 | 58308 | 580 | 349.09 | 352.69 | 352.61 | 353.81 | 0.017393 | 8.5 | 68.24 | 28.17 | 0.96 |
| Reach 1 | 58108 | 580 | 346.97 | 350.85 | | 351.48 | 0.007476 | 6.37 | 91.09 | 30.38 | 0.65 |
| Reach 1 | 57975 | 580 | 345.1 | 350.34 | | 350.75 | 0.003538 | 5.18 | 112.02 | 25.88 | 0.44 |
| Reach 1 | 57804 | 580 | 343.8 | 349.92 | | 350.08 | 0.003443 | 3.18 | 182.34 | 41.67 | 0.27 |
| Reach 1 | 57619 | 580 | 342.5 | 349.43 | | 349.55 | 0.002266 | 2.75 | 210.66 | 43.26 | 0.22 |
| Reach 1 | 57558 | 580 | 341.78 | 349.15 | | 349.34 | 0.004029 | 3.57 | 162.6 | 33.32 | 0.28 |
| Reach 1 | 57509 | 580 | 341.9 | 349.06 | | 349.17 | 0.001958 | 2.67 | 217.42 | 40.92 | 0.2 |

Alt. 2 (Q = 580 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 57388 | 580 | 340.6 | 348.33 | | 348.39 | 0.138045 | 1.97 | 293.88 | 67.79 | 0.17 |
| Reach 1 | 57188 | 580 | 339.1 | 343.76 | | 344.05 | 0.00825 | 4.34 | 133.64 | 37.07 | 0.4 |
| Reach 1 | 57058 | 580 | 337.19 | 342.07 | | 342.56 | 0.015459 | 5.61 | 103.48 | 30.31 | 0.53 |
| Reach 1 | 56979 | 580 | 336.3 | 341.21 | | 341.55 | 0.009214 | 4.66 | 124.38 | 33.05 | 0.42 |
| Reach 1 | 56776 | 580 | 334.1 | 338.99 | | 339.41 | 0.011786 | 5.2 | 111.62 | 29.81 | 0.47 |
| Reach 1 | 56731 | 580 | 334 | 337.91 | 337.18 | 338.97 | 0.003249 | 8.27 | 70.15 | 18 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 580 | 333.3 | 336.48 | 336.48 | 338.09 | 0.005988 | 10.17 | 57.05 | 17.97 | 1.01 |
| Reach 1 | 56670 | 580 | 331.8 | 336.44 | 334.68 | 336.83 | 0.011003 | 5.01 | 115.79 | 31.27 | 0.46 |
| Reach 1 | 56625 | 580 | 330.4 | 336.17 | | 336.43 | 0.005679 | 4.08 | 142.05 | 29.22 | 0.33 |
| Reach 1 | 56596 | 580 | 328.97 | 335.92 | | 336.23 | 0.006558 | 4.47 | 129.78 | 24.18 | 0.34 |
| Reach 1 | 56574 | 580 | 329.8 | 335.66 | | 336.04 | 0.009117 | 4.94 | 117.45 | 26.09 | 0.41 |
| Reach 1 | 56474 | 580 | 329 | 334.66 | | 335.07 | 0.010179 | 5.12 | 113.19 | 26 | 0.43 |
| Reach 1 | 56275 | 580 | 327.3 | 332.77 | | 333.13 | 0.009088 | 4.83 | 120.11 | 27.72 | 0.41 |
| Reach 1 | 56200 | 580 | 326.4 | 332.59 | | 332.71 | 0.00223 | 2.78 | 208.35 | 40.08 | 0.22 |
| Reach 1 | 56100 | 580 | 326 | 332.21 | | 332.4 | 0.003968 | 3.5 | 165.69 | 34.47 | 0.28 |
| Reach 1 | 56074 | 580 | 325.18 | 331.76 | | 332.17 | 0.010243 | 5.19 | 111.65 | 23.75 | 0.42 |
| Reach 1 | 56058 | 580 | 325.18 | 331.52 | | 331.98 | 0.011769 | 5.47 | 106.11 | 23.26 | 0.45 |
| Reach 1 | 56000 | 580 | 325.7 | 330.99 | | 331.34 | 0.008791 | 4.7 | 123.32 | 30.2 | 0.41 |
| Reach 1 | 55902 | 580 | 323.9 | 330.16 | | 330.5 | 0.008226 | 4.74 | 127.44 | 45.65 | 0.39 |
| Reach 1 | 55872 | 580 | 323.8 | 329.82 | | 330.22 | 0.009783 | 5.02 | 115.45 | 27.33 | 0.43 |
| Reach 1 | 55800 | 580 | 323.4 | 329.08 | | 329.48 | 0.010616 | 5.06 | 114.59 | 27.73 | 0.44 |
| Reach 1 | 55706 | 580 | 322.4 | 328.13 | | 328.52 | 0.009764 | 4.97 | 116.6 | 27.97 | 0.43 |
| Reach 1 | 55606 | 580 | 320.3 | 327.47 | | 327.74 | 0.005588 | 4.17 | 139.07 | 27.26 | 0.33 |
| Reach 1 | 55558 | 580 | 321.08 | 326.37 | | 327.12 | 0.021883 | 6.94 | 83.56 | 18.95 | 0.58 |
| Reach 1 | 55505 | 580 | 319.6 | 326.25 | | 326.43 | 0.00375 | 3.48 | 166.8 | 31.41 | 0.27 |
| Reach 1 | 55405 | 580 | 319.1 | 325.44 | | 325.82 | 0.008901 | 4.97 | 116.65 | 23.4 | 0.39 |
| Reach 1 | 55306 | 580 | 318.3 | 324.73 | | 325.02 | 0.006582 | 4.31 | 134.65 | 29.77 | 0.36 |
| Reach 1 | 55206 | 580 | 318 | 324.12 | | 324.37 | 0.006082 | 3.98 | 145.6 | 35.4 | 0.35 |
| Reach 1 | 55108 | 580 | 316.46 | 323.03 | | 323.48 | 0.012448 | 5.41 | 107.14 | 25.32 | 0.46 |
| Reach 1 | 55005 | 580 | 316.1 | 322.21 | | 322.49 | 0.006432 | 4.29 | 142.16 | 72.63 | 0.35 |
| Reach 1 | 54905 | 580 | 315.7 | 321.39 | | 321.7 | 0.009909 | 4.45 | 130.25 | 37.63 | 0.42 |
| Reach 1 | 54805 | 580 | 314.7 | 320.74 | | 320.95 | 0.005209 | 3.78 | 163.74 | 66.66 | 0.31 |
| Reach 1 | 54705 | 580 | 314.5 | 320.4 | | 320.53 | 0.002855 | 2.91 | 199.56 | 45.85 | 0.25 |
| Reach 1 | 54596 | 580 | 313.25 | 319.69 | | 320 | 0.007709 | 4.47 | 129.62 | 30.65 | 0.38 |
| Reach 1 | 54511 | 580 | 312.7 | 319.56 | | 319.68 | 0.003435 | 2.75 | 225.68 | 110.02 | 0.26 |
| Reach 1 | 54496 | 580 | 312.53 | 319.36 | | 319.62 | 0.000245 | 4.1 | 145.87 | 44.14 | 0.33 |
| Reach 1 | 54440 | 580 | 311.9 | 319.19 | | 319.57 | 0.000441 | 5.11 | 203.11 | 220.23 | 0.36 |
| Reach 1 | 54431 | 580 | 311.9 | 318.84 | 315.86 | 319.48 | 0.000838 | 6.44 | 90.09 | 13.06 | 0.43 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 580 | 311.4 | 315.38 | 315.38 | 317.37 | 0.003925 | 11.33 | 51.2 | 12.93 | 1 |
| Reach 1 | 54305 | 580 | 309.9 | 311.61 | 312.74 | 315.53 | 0.361478 | 15.88 | 36.52 | 24.59 | 2.3 |
| Reach 1 | 54296 | 580 | 308.62 | 312.45 | 312.45 | 313.63 | 0.064796 | 8.73 | 66.45 | 28.21 | 1 |

## Alt. 2 (Q = 220 cfs)

HEC-RAS Plan: Alt.1 (Q = 220 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach 1 | 69696 | 220 | 566 | 569.59 | 569.59 | 570.89 | 0.026976 | 9.15 | 24.05 | 9.39 | 1.01 |
| Reach 1 | 69496 | 220 | 562 | 564.19 | 564.36 | 565.22 | 0.028992 | 8.12 | 27.11 | 17.7 | 1.16 |
| Reach 1 | 69196 | 220 | 558 | 560.01 | 559.8 | 560.46 | 0.014558 | 5.34 | 41.17 | 30.87 | 0.82 |
| Reach 1 | 68696 | 220 | 550 | 551.54 | 551.47 | 552.1 | 0.019316 | 6 | 36.64 | 28.68 | 0.94 |
| Reach 1 | 68396 | 220 | 542 | 545.18 | 545.18 | 545.92 | 0.0219 | 6.88 | 31.98 | 21.84 | 1 |
| Reach 1 | 67796 | 220 | 524 | 526.25 | 526.68 | 527.81 | 0.043695 | 10.05 | 21.9 | 13.49 | 1.39 |
| Reach 1 | 67396 | 220 | 516 | 518.08 | 517.88 | 518.57 | 0.014827 | 5.61 | 39.23 | 27.93 | 0.83 |
| Reach 1 | 66996 | 220 | 508.5 | 510.64 | 510.64 | 511.25 | 0.022993 | 6.28 | 35.01 | 29.36 | 1.01 |
| Reach 1 | 66865 | 220 | 503.7 | 506.45 | 505.53 | 506.81 | 0.006379 | 4.83 | 45.55 | 17.87 | 0.53 |
| Reach 1 | 66850 | 220 | 503 | 506.48 | 505.29 | 506.7 | 0.003532 | 3.74 | 58.76 | 24.97 | 0.43 |
| Reach 1 | 66796 | 220 | 504 | 505.57 | 505.57 | 506.27 | 0.022159 | 6.69 | 32.88 | 23.77 | 1 |
| Reach 1 | 66396 | 220 | 494 | 496.23 | 496.28 | 497.02 | 0.024083 | 7.16 | 30.75 | 21.6 | 1.06 |
| Reach 1 | 66246 | 220 | 488 | 491.59 | 490.93 | 491.95 | 0.008174 | 4.8 | 45.85 | 25.52 | 0.63 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 220 | 488 | 490.81 | 490.81 | 491.57 | 0.02271 | 6.98 | 31.5 | 21.16 | 1.01 |
| Reach 1 | 66096 | 220 | 484.5 | 486.31 | 486.65 | 487.43 | 0.057089 | 8.5 | 25.9 | 27.38 | 1.54 |
| Reach 1 | 65796 | 220 | 476 | 477.61 | 477.61 | 478.25 | 0.022146 | 6.46 | 34.07 | 26.44 | 1 |
| Reach 1 | 65196 | 220 | 466 | 467.75 | 467.39 | 468.07 | 0.010166 | 4.59 | 47.89 | 34.85 | 0.69 |
| Reach 1 | 64596 | 220 | 454 | 457.53 | 457.53 | 458.78 | 0.025735 | 8.98 | 24.49 | 9.88 | 1.01 |
| Reach 1 | 63996 | 220 | 442 | 444.69 | 444.56 | 445.45 | 0.017645 | 6.97 | 31.58 | 17.45 | 0.91 |
| Reach 1 | 63696 | 220 | 436 | 438.74 | 438.74 | 439.59 | 0.021603 | 7.42 | 29.66 | 17.68 | 1.01 |
| Reach 1 | 63620 | 220 | 434.1 | 436.97 | 435.92 | 437.23 | 0.004501 | 4.13 | 53.31 | 22.62 | 0.47 |
| Reach 1 | 63596 | 220 | 433.7 | 436.97 | | 437.12 | 0.002358 | 3.07 | 71.61 | 28.96 | 0.34 |
| Reach 1 | 63396 | 220 | 432 | 434.87 | 434.87 | 435.94 | 0.023513 | 8.32 | 26.44 | 12.45 | 1.01 |
| Reach 1 | 62796 | 220 | 416.47 | 418.95 | 419.1 | 419.96 | 0.03034 | 8.05 | 27.31 | 17.62 | 1.14 |
| Reach 1 | 62690 | 220 | 415.18 | 417.08 | 416.84 | 417.68 | 0.015729 | 6.22 | 35.37 | 19.56 | 0.82 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 220 | 414.14 | 416.14 | 416.14 | 416.93 | 0.025673 | 7.13 | 30.87 | 19.95 | 1.01 |
| Reach 1 | 62631 | 220 | 411.86 | 413.88 | 414.42 | 415.55 | 0.080265 | 10.37 | 21.21 | 21.29 | 1.83 |
| Reach 1 | 62596 | 220 | 411 | 413.05 | 413.12 | 413.77 | 0.026633 | 6.82 | 32.24 | 26.38 | 1.09 |
| Reach 1 | 62096 | 220 | 404 | 405.98 | 405.67 | 406.24 | 0.010978 | 4.17 | 52.81 | 47.48 | 0.7 |
| Reach 1 | 61696 | 220 | 398 | 400.3 | 400.1 | 400.85 | 0.016746 | 5.97 | 36.83 | 25.73 | 0.88 |
| Reach 1 | 61396 | 220 | 394 | 396.67 | 396.16 | 397.11 | 0.009473 | 5.34 | 41.22 | 21.9 | 0.69 |
| Reach 1 | 60896 | 220 | 386.5 | 389.45 | 389.45 | 390.18 | 0.021972 | 6.87 | 32 | 21.85 | 1 |
| Reach 1 | 60396 | 220 | 379.6 | 382.63 | 381.26 | 382.74 | 0.002009 | 2.69 | 81.88 | 39.21 | 0.33 |
| Reach 1 | 59796 | 220 | 377.4 | 379.48 | 379.41 | 379.93 | 0.020156 | 5.35 | 41.1 | 39.94 | 0.93 |
| Reach 1 | 59500 | 220 | 371.24 | 372.97 | 372.97 | 373.64 | 0.022216 | 6.56 | 33.54 | 25.34 | 1 |
| Reach 1 | 59396 | 220 | 368.2 | 369.71 | 369.9 | 370.4 | 0.046651 | 6.65 | 33.08 | 43.72 | 1.35 |
| Reach 1 | 59300 | 220 | 365 | 367.24 | 367.24 | 367.88 | 0.022682 | 6.42 | 34.25 | 27.41 | 1.01 |
| Reach 1 | 59100 | 220 | 360.8 | 363.67 | 362.82 | 363.82 | 0.003572 | 3.17 | 69.37 | 40.03 | 0.42 |
| Reach 1 | 59096 | 220 | 360.8 | 362.94 | 362.94 | 363.73 | 0.022128 | 7.14 | 30.81 | 19.78 | 1.01 |
| Reach 1 | 59036 | 220 | 359.6 | 362.08 | 361.83 | 362.6 | 0.013475 | 5.78 | 38.05 | 23.71 | 0.8 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 220 | 359.5 | 361.15 | 361.15 | 361.91 | 0.028753 | 5.76 | 31.7 | 20.74 | 1.07 |
| Reach 1 | 58911 | 220 | 357.1 | 358.73 | 358.79 | 359.33 | 0.028288 | 6.23 | 35.3 | 35.19 | 1.1 |
| Reach 1 | 58822 | 220 | 355.5 | 356.89 | 356.89 | 357.44 | 0.02361 | 5.93 | 37.12 | 34.62 | 1.01 |
| Reach 1 | 58733 | 220 | 353.5 | 356.09 | 354.88 | 356.17 | 0.001556 | 2.23 | 98.58 | 51.68 | 0.28 |
| Reach 1 | 58708 | 220 | 353.05 | 356.08 | | 356.14 | 0.000832 | 1.95 | 112.92 | 41.39 | 0.21 |
| Reach 1 | 58658 | 220 | 353.45 | 355.55 | | 355.99 | 0.012726 | 5.36 | 41.06 | 27.87 | 0.78 |

Alt. 2 (Q = 220 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58608 | 220 | 352.81 | 354.94 | | 355.35 | 0.0121 | 5.18 | 42.43 | 29.17 | 0.76 |
| Reach 1 | 58508 | 220 | 351.32 | 353.82 | | 354.15 | 0.011345 | 4.59 | 47.91 | 37.41 | 0.72 |
| Reach 1 | 58308 | 220 | 349.09 | 351.74 | 351.22 | 352.14 | 0.008869 | 5.06 | 43.49 | 23.85 | 0.66 |
| Reach 1 | 58108 | 220 | 346.97 | 348.78 | 348.78 | 349.45 | 0.02203 | 6.6 | 33.31 | 24.86 | 1.01 |
| Reach 1 | 57975 | 220 | 345.1 | 347.87 | 346.8 | 348.13 | 0.004248 | 4.08 | 53.91 | 21.89 | 0.46 |
| Reach 1 | 57804 | 220 | 343.8 | 347.26 | | 347.36 | 0.00419 | 2.58 | 85.17 | 31.34 | 0.28 |
| Reach 1 | 57619 | 220 | 342.5 | 346.74 | | 346.81 | 0.002112 | 2.04 | 107.73 | 33.39 | 0.2 |
| Reach 1 | 57558 | 220 | 341.78 | 346.54 | | 346.64 | 0.003313 | 2.56 | 85.78 | 25.4 | 0.25 |
| Reach 1 | 57509 | 220 | 341.9 | 346.46 | | 346.51 | 0.001472 | 1.82 | 120.93 | 33.38 | 0.17 |
| Reach 1 | 57388 | 220 | 340.6 | 345.94 | | 345.97 | 0.061413 | 1.34 | 164.2 | 35.55 | 0.11 |
| Reach 1 | 57188 | 220 | 339.1 | 341.74 | | 341.91 | 0.009836 | 3.38 | 65.06 | 30.63 | 0.41 |
| Reach 1 | 57058 | 220 | 337.19 | 340.04 | | 340.33 | 0.014846 | 4.3 | 51.12 | 21.68 | 0.49 |
| Reach 1 | 56979 | 220 | 336.3 | 339.21 | 337.9 | 339.39 | 0.008654 | 3.41 | 64.54 | 26.76 | 0.39 |
| Reach 1 | 56776 | 220 | 334.1 | 336.67 | | 336.97 | 0.016915 | 4.4 | 49.96 | 23.14 | 0.53 |
| Reach 1 | 56731 | 220 | 334 | 336.04 | 335.67 | 336.6 | 0.00331 | 6.01 | 36.63 | 17.95 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 220 | 333.3 | 334.97 | 334.97 | 335.81 | 0.006224 | 7.36 | 29.89 | 17.94 | 1 |
| Reach 1 | 56670 | 220 | 331.8 | 332.79 | 333.36 | 334.73 | 0.321584 | 11.19 | 19.66 | 21.29 | 2.05 |
| Reach 1 | 56625 | 220 | 330.4 | 333.62 | 331.92 | 333.77 | 0.00575 | 3.02 | 72.79 | 25.15 | 0.31 |
| Reach 1 | 56596 | 220 | 328.97 | 333.48 | | 333.62 | 0.004426 | 2.94 | 74.93 | 20.8 | 0.27 |
| Reach 1 | 56574 | 220 | 329.8 | 333.26 | | 333.46 | 0.00841 | 3.62 | 60.78 | 21.14 | 0.38 |
| Reach 1 | 56474 | 220 | 329 | 332.39 | 330.87 | 332.6 | 0.008901 | 3.68 | 59.73 | 21.19 | 0.39 |
| Reach 1 | 56275 | 220 | 327.3 | 330.18 | | 330.44 | 0.013453 | 4.06 | 54.25 | 23.16 | 0.47 |
| Reach 1 | 56200 | 220 | 326.4 | 329.95 | | 330.01 | 0.002161 | 2.01 | 109.34 | 34.8 | 0.2 |
| Reach 1 | 56100 | 220 | 326 | 329.61 | | 329.71 | 0.003886 | 2.6 | 84.53 | 27.95 | 0.26 |
| Reach 1 | 56074 | 220 | 325.18 | 329.34 | | 329.54 | 0.008081 | 3.65 | 60.23 | 18.75 | 0.36 |
| Reach 1 | 56058 | 220 | 325.18 | 329.16 | | 329.39 | 0.00942 | 3.86 | 57.02 | 18.4 | 0.39 |
| Reach 1 | 56000 | 220 | 325.7 | 328.59 | | 328.81 | 0.01075 | 3.77 | 58.31 | 23.94 | 0.43 |
| Reach 1 | 55902 | 220 | 323.9 | 327.75 | | 327.94 | 0.007229 | 3.47 | 63.43 | 20.8 | 0.35 |
| Reach 1 | 55872 | 220 | 323.8 | 327.46 | | 327.68 | 0.009534 | 3.79 | 58 | 21.18 | 0.4 |
| Reach 1 | 55800 | 220 | 323.4 | 326.7 | | 326.94 | 0.011173 | 3.93 | 56 | 21.38 | 0.43 |
| Reach 1 | 55706 | 220 | 322.4 | 325.42 | | 325.72 | 0.014567 | 4.35 | 50.55 | 20.75 | 0.49 |
| Reach 1 | 55606 | 220 | 320.3 | 324.7 | | 324.85 | 0.005005 | 3.07 | 71.75 | 21.43 | 0.3 |
| Reach 1 | 55558 | 220 | 321.08 | 323.72 | | 324.25 | 0.030786 | 5.84 | 37.68 | 15.69 | 0.66 |
| Reach 1 | 55505 | 220 | 319.6 | 323.53 | | 323.62 | 0.003395 | 2.5 | 87.9 | 26.61 | 0.24 |
| Reach 1 | 55405 | 220 | 319.1 | 322.92 | | 323.11 | 0.007299 | 3.51 | 62.69 | 19.43 | 0.34 |
| Reach 1 | 55306 | 220 | 318.3 | 322.3 | | 322.45 | 0.00577 | 3.14 | 70.14 | 23.22 | 0.32 |
| Reach 1 | 55206 | 220 | 318 | 321.57 | | 321.75 | 0.008538 | 3.4 | 64.76 | 26.46 | 0.38 |
| Reach 1 | 55108 | 220 | 316.46 | 320.48 | | 320.75 | 0.011789 | 4.16 | 52.91 | 17.94 | 0.43 |
| Reach 1 | 55005 | 220 | 316.1 | 319.58 | | 319.76 | 0.007482 | 3.4 | 64.62 | 23.25 | 0.36 |
| Reach 1 | 54905 | 220 | 315.7 | 318.73 | | 318.93 | 0.009 | 3.6 | 61.15 | 22.93 | 0.39 |
| Reach 1 | 54805 | 220 | 314.7 | 318.08 | | 318.22 | 0.005367 | 2.96 | 74.27 | 24.92 | 0.3 |
| Reach 1 | 54705 | 220 | 314.5 | 317.61 | | 317.71 | 0.004431 | 2.53 | 87.02 | 34.9 | 0.28 |
| Reach 1 | 54596 | 220 | 313.25 | 316.46 | | 316.79 | 0.017346 | 4.61 | 47.68 | 20.17 | 0.53 |
| Reach 1 | 54511 | 220 | 312.7 | 315.48 | | 315.85 | 0.025098 | 4.9 | 44.89 | 24.21 | 0.63 |
| Reach 1 | 54496 | 220 | 312.53 | 314.74 | 314.74 | 315.61 | 0.003058 | 7.45 | 29.54 | 17.38 | 1.01 |
| Reach 1 | 54440 | 220 | 311.9 | 314.46 | 314.06 | 315.16 | 0.001998 | 6.74 | 32.65 | 13.78 | 0.77 |
| Reach 1 | 54431 | 220 | 311.9 | 314.44 | 313.98 | 315.14 | 0.002051 | 6.7 | 32.82 | 12.96 | 0.74 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 220 | 311.4 | 313.48 | 313.48 | 314.53 | 0.003758 | 8.23 | 26.75 | 12.87 | 1.01 |
| Reach 1 | 54305 | 220 | 309.9 | 310.84 | 311.46 | 313.01 | 0.408111 | 11.8 | 18.64 | 22.04 | 2.26 |
| Reach 1 | 54296 | 220 | 308.62 | 311.19 | 311.19 | 311.87 | 0.074518 | 6.62 | 33.22 | 24.45 | 1 |

# Alt. 3 (Q = 1180 cfs)

HEC-RAS Plan: Alt.2 (Q = 1180 cfs) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 1180 | 566 | 573.82 | 573.88 | 575.56 | 0.020001 | 10.58 | 111.54 | 33.7 | 1.02 |
| Reach 1 | 69496 | 1180 | 562 | 566.51 | 567.52 | 569.79 | 0.042289 | 14.53 | 81.2 | 29 | 1.53 |
| Reach 1 | 69196 | 1180 | 558 | 562.31 | 562.22 | 563.62 | 0.015854 | 9.17 | 128.68 | 45.15 | 0.96 |
| Reach 1 | 68696 | 1180 | 550 | 553.92 | 553.92 | 555.27 | 0.017596 | 9.32 | 126.64 | 47.55 | 1.01 |
| Reach 1 | 68396 | 1180 | 542 | 547.73 | 547.95 | 549.37 | 0.021868 | 10.29 | 114.65 | 43.07 | 1.11 |
| Reach 1 | 67796 | 1180 | 524 | 529.41 | 530.48 | 532.68 | 0.035765 | 14.51 | 81.32 | 24.05 | 1.39 |
| Reach 1 | 67396 | 1180 | 516 | 520.24 | 520.35 | 521.6 | 0.020131 | 9.34 | 126.32 | 52.64 | 1.06 |
| Reach 1 | 66996 | 1180 | 508.5 | 513.02 | 513.02 | 514.32 | 0.017431 | 9.17 | 128.71 | 49.36 | 1 |
| Reach 1 | 66865 | 1180 | 503.7 | 508.85 | 509.06 | 511.49 | 0.024842 | 13.03 | 90.59 | 19.65 | 1.07 |
| Reach 1 | 66850 | 1180 | 503 | 509.8 | 508.32 | 510.65 | 0.006115 | 7.38 | 159.96 | 36 | 0.62 |
| Reach 1 | 66796 | 1180 | 504 | 508.36 | 508.36 | 510.04 | 0.017439 | 10.42 | 113.23 | 33.98 | 1.01 |
| Reach 1 | 66396 | 1180 | 494 | 498.47 | 499.1 | 500.78 | 0.031708 | 12.21 | 96.65 | 37.27 | 1.34 |
| Reach 1 | 66246 | 1180 | 488 | 496.41 | 493.83 | 496.71 | 0.002316 | 4.41 | 267.39 | 66.47 | 0.39 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 1180 | 488 | 493.53 | 493.53 | 494.8 | 0.018085 | 9.04 | 130.57 | 51.74 | 1 |
| Reach 1 | 66096 | 1180 | 484.5 | 487.92 | 488.91 | 490.95 | 0.062395 | 13.97 | 84.49 | 45.15 | 1.8 |
| Reach 1 | 65796 | 1180 | 476 | 480.14 | 480.14 | 481.59 | 0.017439 | 9.68 | 121.91 | 42.53 | 1.01 |
| Reach 1 | 65196 | 1180 | 466 | 470.71 | 469.65 | 471.32 | 0.006468 | 6.24 | 189.13 | 61.55 | 0.63 |
| Reach 1 | 64596 | 1180 | 454 | 462.43 | 462.43 | 464.71 | 0.021214 | 12.11 | 97.48 | 21.78 | 1.01 |
| Reach 1 | 63996 | 1180 | 442 | 447.28 | 447.92 | 449.89 | 0.029213 | 12.97 | 90.98 | 28.45 | 1.28 |
| Reach 1 | 63696 | 1180 | 436 | 441.98 | 441.98 | 443.74 | 0.017082 | 10.65 | 110.83 | 31.51 | 1 |
| Reach 1 | 63620 | 1180 | 434.1 | 441.96 | 439.05 | 442.55 | 0.003268 | 6.17 | 191.27 | 30.55 | 0.43 |
| Reach 1 | 63596 | 1180 | 433.7 | 442.02 | | 442.43 | 0.002105 | 5.14 | 229.74 | 33.71 | 0.35 |
| Reach 1 | 63396 | 1180 | 432 | 439.02 | 439.02 | 441.29 | 0.020075 | 12.1 | 97.54 | 21.79 | 1.01 |
| Reach 1 | 62796 | 1180 | 416.47 | 421.75 | 422.66 | 425.18 | 0.037094 | 14.86 | 79.41 | 20.68 | 1.34 |
| Reach 1 | 62690 | 1180 | 415.18 | 420.52 | 420.11 | 422.57 | 0.018313 | 11.48 | 102.82 | 19.65 | 0.88 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 1180 | 414.14 | 419.37 | 419.37 | 421.73 | 0.023588 | 12.35 | 95.57 | 20.19 | 1 |
| Reach 1 | 62631 | 1180 | 411.86 | 415.5 | 416.86 | 420.22 | 0.089783 | 17.43 | 67.71 | 33.43 | 2.16 |
| Reach 1 | 62596 | 1180 | 411 | 414.77 | 415.57 | 417.56 | 0.042249 | 13.4 | 88.07 | 36.31 | 1.52 |
| Reach 1 | 62096 | 1180 | 404 | 407.56 | 407.49 | 408.43 | 0.017868 | 7.45 | 158.35 | 85.51 | 0.97 |
| Reach 1 | 61696 | 1180 | 398 | 403.24 | | 403.86 | 0.0077 | 6.32 | 186.7 | 67.65 | 0.67 |
| Reach 1 | 61396 | 1180 | 394 | 399.75 | | 401 | 0.011567 | 8.97 | 131.58 | 36.78 | 0.84 |
| Reach 1 | 60896 | 1180 | 386.5 | 392.28 | 392.28 | 393.93 | 0.017423 | 10.33 | 114.27 | 34.65 | 1 |
| Reach 1 | 60396 | 1180 | 379.6 | 385.8 | 383.67 | 386.16 | 0.002895 | 4.86 | 242.64 | 62.32 | 0.43 |
| Reach 1 | 59796 | 1180 | 377.4 | 381.31 | 381.31 | 382.54 | 0.017921 | 8.92 | 132.31 | 53.93 | 1 |
| Reach 1 | 59500 | 1180 | 371.24 | 375.13 | 375.28 | 376.23 | 0.0255 | 8.44 | 139.78 | 80.59 | 1.13 |
| Reach 1 | 59396 | 1180 | 368.2 | 371.11 | 371.61 | 372.91 | 0.039131 | 10.77 | 109.53 | 61.28 | 1.42 |
| Reach 1 | 59300 | 1180 | 364.3 | 369.09 | 369.09 | 370.57 | 0.017153 | 9.76 | 120.93 | 41.15 | 1 |
| Reach 1 | 59100 | 1180 | 360.3 | 367.17 | 364.69 | 367.52 | 0.002283 | 4.78 | 246.68 | 53.11 | 0.39 |
| Reach 1 | 59096 | 1180 | 360.2 | 365.84 | | 367.39 | 0.012556 | 9.98 | 118.24 | 27.49 | 0.85 |
| Reach 1 | 59036 | 1180 | 359 | 365.6 | 364.26 | 366.67 | 0.007436 | 8.33 | 141.72 | 28.4 | 0.66 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 1180 | 359 | 364.26 | 364.26 | 366.23 | 0.017739 | 11.25 | 104.85 | 26.73 | 1 |
| Reach 1 | 58911 | 1180 | 359 | 361.56 | 362.2 | 363.87 | 0.042116 | 12.19 | 96.84 | 46.43 | 1.49 |
| Reach 1 | 58909 | 1180 | 359 | 361.74 | 362.2 | 363.7 | 0.03269 | 11.24 | 104.96 | 46.83 | 1.32 |
| Reach 1 | 58908 | 1180 | 357.4 | 359.45 | 360.63 | 363.44 | 0.09192 | 16.03 | 73.63 | 42.69 | 2.15 |
| Reach 1 | 58822 | 1180 | 356 | 360.32 | 359.48 | 361.14 | 0.007874 | 7.27 | 162.42 | 47.74 | 0.69 |
| Reach 1 | 58809 | 1180 | 356.13 | 359.53 | 359.53 | 360.94 | 0.017578 | 9.53 | 123.85 | 44.54 | 1.01 |
| Reach 1 | 58808 | 1180 | 354.13 | 359.39 | 357.28 | 359.7 | 0.002309 | 4.52 | 260.95 | 60.26 | 0.38 |
| Reach 1 | 58733 | 1180 | 353.3 | 359.3 | | 359.54 | 0.001511 | 3.98 | 296.29 | 60.22 | 0.32 |

Alt. 3 (Q = 1180 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58708 | 1180 | 353.05 | 359.11 | | 359.48 | 0.002322 | 4.94 | 240.41 | 44.29 | 0.36 |
| Reach 1 | 58658 | 1180 | 353.45 | 357.91 | 357.76 | 359.16 | 0.014669 | 8.96 | 131.72 | 45.52 | 0.93 |
| Reach 1 | 58608 | 1180 | 352.81 | 357.35 | | 358.39 | 0.013487 | 8.19 | 144.12 | 53.86 | 0.88 |
| Reach 1 | 58508 | 1180 | 351.32 | 356.9 | | 357.47 | 0.005066 | 6.06 | 194.56 | 53.51 | 0.56 |
| Reach 1 | 58308 | 1180 | 349.09 | 354.52 | 354.14 | 355.87 | 0.012646 | 9.31 | 126.78 | 35.35 | 0.87 |
| Reach 1 | 58108 | 1180 | 346.97 | 353.5 | | 354.12 | 0.005145 | 6.32 | 186.66 | 47.3 | 0.56 |
| Reach 1 | 57975 | 1180 | 345.1 | 352.96 | | 353.53 | 0.003675 | 6.07 | 194.36 | 37.02 | 0.47 |
| Reach 1 | 57804 | 1180 | 343.8 | 352.59 | | 352.82 | 0.003416 | 3.83 | 307.8 | 52.38 | 0.28 |
| Reach 1 | 57619 | 1180 | 342.5 | 352.06 | | 352.25 | 0.002592 | 3.5 | 337.22 | 52.94 | 0.24 |
| Reach 1 | 57558 | 1180 | 341.78 | 351.67 | | 352 | 0.004874 | 4.62 | 255.61 | 40.4 | 0.32 |
| Reach 1 | 57509 | 1180 | 341.9 | 351.56 | | 351.76 | 0.002581 | 3.59 | 329.1 | 48.2 | 0.24 |
| Reach 1 | 57388 | 1180 | 340.6 | 350.63 | | 350.73 | 0.152537 | 2.56 | 461.38 | 77.46 | 0.18 |
| Reach 1 | 57188 | 1180 | 339.1 | 345.98 | | 346.41 | 0.007988 | 5.24 | 225.07 | 45.35 | 0.41 |
| Reach 1 | 57058 | 1180 | 337.19 | 344.42 | | 345.04 | 0.012989 | 6.33 | 186.47 | 39.84 | 0.52 |
| Reach 1 | 56979 | 1180 | 336.3 | 343.69 | | 344.16 | 0.008207 | 5.46 | 216.16 | 40.87 | 0.42 |
| Reach 1 | 56776 | 1180 | 334.1 | 342.09 | | 342.54 | 0.007718 | 5.43 | 217.47 | 38.66 | 0.4 |
| Reach 1 | 56731 | 1180 | 334 | 339.38 | 339.12 | 341.69 | 0.005336 | 12.21 | 96.67 | 18.03 | 0.93 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 1180 | 333.3 | 338.42 | 338.42 | 340.98 | 0.006143 | 12.83 | 92.01 | 18.02 | 1 |
| Reach 1 | 56670 | 1180 | 331.8 | 339.22 | 336.24 | 339.7 | 0.008226 | 5.54 | 213.15 | 38.85 | 0.42 |
| Reach 1 | 56625 | 1180 | 330.4 | 338.93 | | 339.35 | 0.00614 | 5.16 | 228.85 | 33.64 | 0.35 |
| Reach 1 | 56596 | 1180 | 328.97 | 338.54 | | 339.1 | 0.008542 | 5.96 | 197.95 | 27.81 | 0.39 |
| Reach 1 | 56574 | 1180 | 329.8 | 338.32 | | 338.89 | 0.009497 | 6.08 | 194.14 | 31.58 | 0.43 |
| Reach 1 | 56474 | 1180 | 329 | 337.29 | | 337.9 | 0.010308 | 6.25 | 188.92 | 31.57 | 0.45 |
| Reach 1 | 56275 | 1180 | 327.3 | 335.41 | | 335.95 | 0.009027 | 5.92 | 199.33 | 32.37 | 0.42 |
| Reach 1 | 56200 | 1180 | 326.4 | 335.24 | | 335.45 | 0.002662 | 3.67 | 324.62 | 61.6 | 0.24 |
| Reach 1 | 56100 | 1180 | 326 | 334.93 | | 335.14 | 0.003416 | 3.91 | 331.78 | 98.51 | 0.27 |
| Reach 1 | 56074 | 1180 | 325.18 | 334.13 | | 334.84 | 0.012385 | 6.78 | 175.45 | 34.59 | 0.48 |
| Reach 1 | 56058 | 1180 | 325.18 | 333.8 | | 334.6 | 0.01463 | 7.17 | 164.83 | 30.37 | 0.52 |
| Reach 1 | 56000 | 1180 | 325.7 | 333.44 | | 333.82 | 0.007062 | 5.13 | 275.37 | 167.57 | 0.38 |
| Reach 1 | 55902 | 1180 | 323.9 | 333.02 | | 333.2 | 0.004139 | 3.8 | 375.19 | 180.06 | 0.29 |
| Reach 1 | 55872 | 1180 | 323.8 | 332.28 | | 332.87 | 0.010699 | 6.2 | 190.37 | 34.62 | 0.47 |
| Reach 1 | 55800 | 1180 | 323.4 | 331.53 | | 332.1 | 0.010709 | 6.1 | 205.28 | 100.42 | 0.46 |
| Reach 1 | 55706 | 1180 | 322.4 | 330.79 | | 331.19 | 0.007264 | 5.29 | 261.37 | 139.16 | 0.39 |
| Reach 1 | 55606 | 1180 | 320.3 | 330.34 | | 330.58 | 0.004134 | 4.22 | 332.21 | 147.79 | 0.29 |
| Reach 1 | 55558 | 1180 | 321.08 | 328.53 | | 329.85 | 0.025807 | 9.23 | 129.63 | 25.95 | 0.65 |
| Reach 1 | 55505 | 1180 | 319.6 | 328.62 | | 328.87 | 0.00399 | 4.18 | 314.68 | 97.84 | 0.28 |
| Reach 1 | 55405 | 1180 | 319.1 | 327.68 | | 328.19 | 0.009961 | 6 | 220.81 | 82.17 | 0.42 |
| Reach 1 | 55306 | 1180 | 318.3 | 326.9 | | 327.21 | 0.008021 | 4.75 | 274.96 | 115.81 | 0.4 |
| Reach 1 | 55206 | 1180 | 318 | 326.33 | | 326.53 | 0.005105 | 3.84 | 330.61 | 119.57 | 0.32 |
| Reach 1 | 55108 | 1180 | 316.46 | 324.58 | | 325.45 | 0.01945 | 7.6 | 162.03 | 43.76 | 0.6 |
| Reach 1 | 55005 | 1180 | 316.1 | 323.98 | | 324.19 | 0.005261 | 3.93 | 324.79 | 125.54 | 0.32 |
| Reach 1 | 54905 | 1180 | 315.7 | 323.39 | | 323.6 | 0.006511 | 3.93 | 327.84 | 148.16 | 0.35 |
| Reach 1 | 54805 | 1180 | 314.7 | 323.02 | | 323.13 | 0.002954 | 2.62 | 443.2 | 159.29 | 0.24 |
| Reach 1 | 54705 | 1180 | 314.5 | 322.85 | | 322.93 | 0.001315 | 2.53 | 563.31 | 240 | 0.18 |
| Reach 1 | 54596 | 1180 | 313.25 | 322.16 | | 322.56 | 0.00605 | 5.26 | 241.06 | 58.91 | 0.36 |
| Reach 1 | 54511 | 1180 | 312.7 | 322.27 | | 322.31 | 0.000689 | 1.72 | 745.48 | 215 | 0.13 |
| Reach 1 | 54496 | 1180 | 312.53 | 321.9 | | 322.22 | 0.000195 | 4.84 | 403.37 | 105.45 | 0.31 |
| Reach 1 | 54440 | 1180 | 311.9 | 322.01 | | 322.1 | 0.000126 | 3.49 | 1084.65 | 400 | 0.2 |
| Reach 1 | 54431 | 1180 | 311.9 | 322.02 | 318.28 | 322.07 | 0.000126 | 2.97 | 1522.92 | 790 | 0.17 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 1180 | 311.4 | 317.78 | 317.78 | 320.97 | 0.004401 | 14.33 | 82.33 | 13.02 | 1 |
| Reach 1 | 54305 | 1180 | 309.9 | 312.48 | 314.31 | 318.63 | 0.35638 | 19.9 | 59.29 | 27.5 | 2.39 |
| Reach 1 | 54296 | 1180 | 308.62 | 313.97 | 313.97 | 315.65 | 0.059007 | 10.4 | 113.45 | 33.79 | 1 |

# Alt. 3 (Q = 580)

HEC-RAS Plan: Alt.2 (Q = 580) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 580 | 566 | 572.05 | 572.05 | 573.43 | 0.021958 | 9.42 | 61.56 | 22.72 | 1.01 |
| Reach 1 | 69496 | 580 | 562 | 565.25 | 565.9 | 567.47 | 0.041143 | 11.96 | 48.5 | 22.84 | 1.45 |
| Reach 1 | 69196 | 580 | 558 | 561.16 | 560.93 | 561.96 | 0.014354 | 7.19 | 80.61 | 37.98 | 0.87 |
| Reach 1 | 68696 | 580 | 550 | 552.64 | 552.64 | 553.63 | 0.019423 | 8 | 72.52 | 36.91 | 1.01 |
| Reach 1 | 68396 | 580 | 542 | 546.52 | 546.57 | 547.63 | 0.020614 | 8.46 | 68.54 | 32.96 | 1.03 |
| Reach 1 | 67796 | 580 | 524 | 527.7 | 528.46 | 530.28 | 0.042543 | 12.89 | 45 | 18.33 | 1.45 |
| Reach 1 | 67396 | 580 | 516 | 519.21 | 519.11 | 520.07 | 0.017359 | 7.44 | 77.92 | 40.87 | 0.95 |
| Reach 1 | 66996 | 580 | 508.5 | 511.78 | 511.78 | 512.73 | 0.019305 | 7.83 | 74.07 | 38.96 | 1 |
| Reach 1 | 66865 | 580 | 503.7 | 506.47 | 507.11 | 508.95 | 0.043233 | 12.63 | 45.94 | 17.88 | 1.39 |
| Reach 1 | 66850 | 580 | 503 | 508.09 | 506.69 | 508.58 | 0.004974 | 5.62 | 103.22 | 30.32 | 0.54 |
| Reach 1 | 66796 | 580 | 504 | 506.86 | 506.86 | 508.04 | 0.019262 | 8.73 | 66.47 | 28.49 | 1.01 |
| Reach 1 | 66396 | 580 | 494 | 497.36 | 497.67 | 498.83 | 0.027894 | 9.71 | 59.72 | 29.53 | 1.2 |
| Reach 1 | 66246 | 580 | 488 | 491.83 | 492.39 | 493.75 | 0.04103 | 11.14 | 52.06 | 27.51 | 1.43 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 580 | 488 | 492.22 | 492.23 | 493.22 | 0.02027 | 8.03 | 72.25 | 36.94 | 1.01 |
| Reach 1 | 66096 | 580 | 484.5 | 487.07 | 487.73 | 489.15 | 0.063085 | 11.58 | 50.09 | 35.81 | 1.73 |
| Reach 1 | 65796 | 580 | 476 | 478.82 | 478.82 | 479.86 | 0.019208 | 8.19 | 70.8 | 34.3 | 1 |
| Reach 1 | 65196 | 580 | 466 | 469.12 | 468.46 | 469.61 | 0.007924 | 5.59 | 103.82 | 46.53 | 0.66 |
| Reach 1 | 64596 | 580 | 454 | 459.86 | 459.86 | 461.79 | 0.024026 | 11.14 | 52.04 | 13.77 | 1.01 |
| Reach 1 | 63996 | 580 | 442 | 446.02 | 446.2 | 447.55 | 0.023071 | 9.91 | 58.55 | 23.1 | 1.1 |
| Reach 1 | 63696 | 580 | 436 | 440.33 | 440.33 | 441.6 | 0.018713 | 9.05 | 64.09 | 25.25 | 1 |
| Reach 1 | 63620 | 580 | 434.1 | 439.33 | 437.37 | 439.73 | 0.003625 | 5.12 | 113.39 | 28.38 | 0.45 |
| Reach 1 | 63596 | 580 | 433.7 | 439.37 | | 439.62 | 0.00199 | 4.04 | 143.64 | 31.21 | 0.33 |
| Reach 1 | 63396 | 580 | 432 | 436.87 | 436.87 | 438.54 | 0.021511 | 10.38 | 55.89 | 16.96 | 1.01 |
| Reach 1 | 62796 | 580 | 416.47 | 420.18 | 420.65 | 422.33 | 0.034656 | 11.77 | 49.29 | 18.12 | 1.26 |
| Reach 1 | 62690 | 580 | 415.18 | 418.66 | 418.27 | 419.85 | 0.015923 | 8.74 | 66.39 | 19.6 | 0.84 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 580 | 414.14 | 417.57 | 417.57 | 419.05 | 0.02347 | 9.77 | 59.39 | 20.06 | 1 |
| Reach 1 | 62631 | 580 | 411.86 | 414.7 | 415.57 | 417.64 | 0.086528 | 13.77 | 42.11 | 29.19 | 2.02 |
| Reach 1 | 62596 | 580 | 411 | 413.96 | 414.3 | 415.43 | 0.033175 | 9.71 | 59.75 | 33.7 | 1.28 |
| Reach 1 | 62096 | 580 | 404 | 406.85 | 406.58 | 407.34 | 0.013307 | 5.62 | 103.22 | 68.31 | 0.81 |
| Reach 1 | 61696 | 580 | 398 | 401.84 | | 402.37 | 0.011577 | 5.83 | 99.53 | 55.41 | 0.77 |
| Reach 1 | 61396 | 580 | 394 | 398.19 | | 399 | 0.010719 | 7.25 | 80.03 | 29.23 | 0.77 |
| Reach 1 | 60896 | 580 | 386.5 | 390.8 | 390.8 | 391.95 | 0.019133 | 8.64 | 67.15 | 29.02 | 1 |
| Reach 1 | 60396 | 580 | 379.6 | 384.19 | 382.39 | 384.41 | 0.00252 | 3.82 | 151.78 | 50.57 | 0.39 |
| Reach 1 | 59796 | 580 | 377.4 | 380.38 | 380.33 | 381.13 | 0.018473 | 6.95 | 83.47 | 51.14 | 0.96 |
| Reach 1 | 59500 | 580 | 371.24 | 374.49 | 374.49 | 375.13 | 0.022054 | 6.42 | 90.35 | 70.54 | 1 |
| Reach 1 | 59396 | 580 | 368.2 | 370.28 | 370.69 | 371.65 | 0.053944 | 9.38 | 61.84 | 54.37 | 1.55 |
| Reach 1 | 59300 | 580 | 364.3 | 367.83 | 367.83 | 368.84 | 0.019391 | 8.08 | 71.77 | 35.99 | 1.01 |
| Reach 1 | 59100 | 580 | 360.3 | 364.84 | 363.49 | 365.14 | 0.003549 | 4.4 | 131.72 | 45.61 | 0.46 |
| Reach 1 | 59096 | 580 | 360.2 | 363.95 | 363.69 | 365.04 | 0.014595 | 8.4 | 69.05 | 24.42 | 0.88 |
| Reach 1 | 59036 | 580 | 359 | 363.67 | 362.67 | 364.33 | 0.006889 | 6.49 | 89.32 | 26.13 | 0.62 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 580 | 359 | 362.57 | 362.57 | 363.91 | 0.019363 | 9.31 | 62.27 | 23.47 | 1.01 |
| Reach 1 | 58911 | 580 | 359 | 361.4 | 361.14 | 362.05 | 0.013102 | 6.49 | 89.38 | 46.06 | 0.82 |
| Reach 1 | 58909 | 580 | 359 | 361.14 | 361.14 | 362.01 | 0.020525 | 7.48 | 77.59 | 45.47 | 1.01 |
| Reach 1 | 58908 | 580 | 356 | 357.23 | 358.29 | 361.61 | 0.210609 | 16.78 | 34.56 | 34.96 | 2.97 |
| Reach 1 | 58822 | 580 | 356 | 358.92 | 358.29 | 359.45 | 0.00807 | 5.82 | 99.66 | 42.07 | 0.67 |
| Reach 1 | 58809 | 580 | 356 | 358.29 | 358.29 | 359.25 | 0.01977 | 7.83 | 74.06 | 39.43 | 1.01 |
| Reach 1 | 58808 | 580 | 353 | 357.8 | 355.41 | 357.92 | 0.001093 | 2.77 | 209.13 | 59.54 | 0.26 |
| Reach 1 | 58733 | 580 | 353 | 357.72 | | 357.84 | 0.001184 | 2.84 | 203.9 | 59.5 | 0.27 |

Alt. 3 (Q = 580)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58708 | 580 | 353.05 | 357.64 | | 357.8 | 0.001394 | 3.27 | 177.64 | 41.55 | 0.28 |
| Reach 1 | 58658 | 580 | 353.45 | 356.96 | | 357.6 | 0.010867 | 6.42 | 90.35 | 41.43 | 0.77 |
| Reach 1 | 58608 | 580 | 352.81 | 356.04 | 355.87 | 356.87 | 0.018927 | 7.32 | 79.19 | 45.29 | 0.98 |
| Reach 1 | 58508 | 580 | 351.32 | 355.38 | | 355.77 | 0.005875 | 4.97 | 116.6 | 48.99 | 0.57 |
| Reach 1 | 58308 | 580 | 349.09 | 352.69 | 352.61 | 353.81 | 0.017393 | 8.5 | 68.24 | 28.17 | 0.96 |
| Reach 1 | 58108 | 580 | 346.97 | 350.85 | | 351.48 | 0.007476 | 6.37 | 91.09 | 30.38 | 0.65 |
| Reach 1 | 57975 | 580 | 345.1 | 350.34 | | 350.75 | 0.003538 | 5.18 | 112.02 | 25.88 | 0.44 |
| Reach 1 | 57804 | 580 | 343.8 | 349.92 | | 350.08 | 0.003443 | 3.18 | 182.34 | 41.67 | 0.27 |
| Reach 1 | 57619 | 580 | 342.5 | 349.43 | | 349.55 | 0.002266 | 2.75 | 210.66 | 43.26 | 0.22 |
| Reach 1 | 57558 | 580 | 341.78 | 349.15 | | 349.34 | 0.004029 | 3.57 | 162.6 | 33.32 | 0.28 |
| Reach 1 | 57509 | 580 | 341.9 | 349.06 | | 349.17 | 0.001958 | 2.67 | 217.42 | 40.92 | 0.2 |
| Reach 1 | 57388 | 580 | 340.6 | 348.33 | | 348.39 | 0.138045 | 1.97 | 293.88 | 67.79 | 0.17 |
| Reach 1 | 57188 | 580 | 339.1 | 343.76 | | 344.05 | 0.00825 | 4.34 | 133.64 | 37.07 | 0.4 |
| Reach 1 | 57058 | 580 | 337.19 | 342.07 | | 342.56 | 0.015459 | 5.61 | 103.48 | 30.31 | 0.53 |
| Reach 1 | 56979 | 580 | 336.3 | 341.21 | | 341.55 | 0.009214 | 4.66 | 124.38 | 33.05 | 0.42 |
| Reach 1 | 56776 | 580 | 334.1 | 338.99 | | 339.41 | 0.011786 | 5.2 | 111.62 | 29.81 | 0.47 |
| Reach 1 | 56731 | 580 | 334 | 337.91 | 337.18 | 338.97 | 0.003249 | 8.27 | 70.15 | 18 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 580 | 333.3 | 336.48 | 336.48 | 338.09 | 0.005988 | 10.17 | 57.05 | 17.97 | 1.01 |
| Reach 1 | 56670 | 580 | 331.8 | 336.44 | 334.68 | 336.83 | 0.011003 | 5.01 | 115.79 | 31.27 | 0.46 |
| Reach 1 | 56625 | 580 | 330.4 | 336.17 | | 336.43 | 0.005679 | 4.08 | 142.05 | 29.22 | 0.33 |
| Reach 1 | 56596 | 580 | 328.97 | 335.92 | | 336.23 | 0.006558 | 4.47 | 129.78 | 24.18 | 0.34 |
| Reach 1 | 56574 | 580 | 329.8 | 335.66 | | 336.04 | 0.009117 | 4.94 | 117.45 | 26.09 | 0.41 |
| Reach 1 | 56474 | 580 | 329 | 334.66 | | 335.07 | 0.010179 | 5.12 | 113.19 | 26 | 0.43 |
| Reach 1 | 56275 | 580 | 327.3 | 332.77 | | 333.13 | 0.009088 | 4.83 | 120.11 | 27.72 | 0.41 |
| Reach 1 | 56200 | 580 | 326.4 | 332.59 | | 332.71 | 0.00223 | 2.78 | 208.35 | 40.08 | 0.22 |
| Reach 1 | 56100 | 580 | 326 | 332.21 | | 332.4 | 0.003968 | 3.5 | 165.69 | 34.47 | 0.28 |
| Reach 1 | 56074 | 580 | 325.18 | 331.76 | | 332.17 | 0.010243 | 5.19 | 111.65 | 23.75 | 0.42 |
| Reach 1 | 56058 | 580 | 325.18 | 331.52 | | 331.98 | 0.011769 | 5.47 | 106.11 | 23.26 | 0.45 |
| Reach 1 | 56000 | 580 | 325.7 | 330.99 | | 331.34 | 0.008791 | 4.7 | 123.32 | 30.2 | 0.41 |
| Reach 1 | 55902 | 580 | 323.9 | 330.16 | | 330.5 | 0.008226 | 4.74 | 127.44 | 45.65 | 0.39 |
| Reach 1 | 55872 | 580 | 323.8 | 329.82 | | 330.22 | 0.009783 | 5.02 | 115.45 | 27.33 | 0.43 |
| Reach 1 | 55800 | 580 | 323.4 | 329.08 | | 329.48 | 0.010616 | 5.06 | 114.59 | 27.73 | 0.44 |
| Reach 1 | 55706 | 580 | 322.4 | 328.13 | | 328.52 | 0.009764 | 4.97 | 116.6 | 27.97 | 0.43 |
| Reach 1 | 55606 | 580 | 320.3 | 327.47 | | 327.74 | 0.005588 | 4.17 | 139.07 | 27.26 | 0.33 |
| Reach 1 | 55558 | 580 | 321.08 | 326.37 | | 327.12 | 0.021883 | 6.94 | 83.56 | 18.95 | 0.58 |
| Reach 1 | 55505 | 580 | 319.6 | 326.25 | | 326.43 | 0.00375 | 3.48 | 166.8 | 31.41 | 0.27 |
| Reach 1 | 55405 | 580 | 319.1 | 325.44 | | 325.82 | 0.008901 | 4.97 | 116.65 | 23.4 | 0.39 |
| Reach 1 | 55306 | 580 | 318.3 | 324.73 | | 325.02 | 0.006582 | 4.31 | 134.65 | 29.77 | 0.36 |
| Reach 1 | 55206 | 580 | 318 | 324.12 | | 324.37 | 0.006082 | 3.98 | 145.6 | 35.4 | 0.35 |
| Reach 1 | 55108 | 580 | 316.46 | 323.03 | | 323.48 | 0.012448 | 5.41 | 107.14 | 25.32 | 0.46 |
| Reach 1 | 55005 | 580 | 316.1 | 322.21 | | 322.49 | 0.006432 | 4.29 | 142.16 | 72.63 | 0.35 |
| Reach 1 | 54905 | 580 | 315.7 | 321.39 | | 321.7 | 0.009909 | 4.45 | 130.25 | 37.63 | 0.42 |
| Reach 1 | 54805 | 580 | 314.7 | 320.74 | | 320.95 | 0.005209 | 3.78 | 163.74 | 66.66 | 0.31 |
| Reach 1 | 54705 | 580 | 314.5 | 320.4 | | 320.53 | 0.002855 | 2.91 | 199.56 | 45.85 | 0.25 |
| Reach 1 | 54596 | 580 | 313.25 | 319.69 | | 320 | 0.007709 | 4.47 | 129.62 | 30.65 | 0.38 |
| Reach 1 | 54511 | 580 | 312.7 | 319.56 | | 319.68 | 0.003435 | 2.75 | 225.68 | 110.02 | 0.26 |
| Reach 1 | 54496 | 580 | 312.53 | 319.36 | | 319.62 | 0.000245 | 4.1 | 145.87 | 44.14 | 0.33 |
| Reach 1 | 54440 | 580 | 311.9 | 319.19 | | 319.57 | 0.000441 | 5.11 | 203.11 | 220.23 | 0.36 |
| Reach 1 | 54431 | 580 | 311.9 | 318.84 | 315.86 | 319.48 | 0.000838 | 6.44 | 90.09 | 13.06 | 0.43 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 580 | 311.4 | 315.38 | 315.38 | 317.37 | 0.003925 | 11.33 | 51.2 | 12.93 | 1 |
| Reach 1 | 54305 | 580 | 309.9 | 311.61 | 312.74 | 315.53 | 0.361478 | 15.88 | 36.52 | 24.59 | 2.3 |
| Reach 1 | 54296 | 580 | 308.62 | 312.45 | 312.45 | 313.63 | 0.064796 | 8.73 | 66.45 | 28.21 | 1 |

# Alt. 3 (Q = 220)

HEC-RAS Plan: Alt.2 (Q = 220) River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 220 | 566 | 569.59 | 569.59 | 570.89 | 0.026976 | 9.15 | 24.05 | 9.39 | 1.01 |
| Reach 1 | 69496 | 220 | 562 | 564.19 | 564.36 | 565.22 | 0.028992 | 8.12 | 27.11 | 17.7 | 1.16 |
| Reach 1 | 69196 | 220 | 558 | 560.01 | 559.8 | 560.46 | 0.014558 | 5.34 | 41.17 | 30.87 | 0.82 |
| Reach 1 | 68696 | 220 | 550 | 551.54 | 551.47 | 552.1 | 0.019316 | 6 | 36.64 | 28.68 | 0.94 |
| Reach 1 | 68396 | 220 | 542 | 545.18 | 545.18 | 545.92 | 0.0219 | 6.88 | 31.98 | 21.84 | 1 |
| Reach 1 | 67796 | 220 | 524 | 526.25 | 526.68 | 527.81 | 0.043695 | 10.05 | 21.9 | 13.49 | 1.39 |
| Reach 1 | 67396 | 220 | 516 | 518.08 | 517.88 | 518.57 | 0.014827 | 5.61 | 39.23 | 27.93 | 0.83 |
| Reach 1 | 66996 | 220 | 508.5 | 510.64 | 510.64 | 511.25 | 0.022993 | 6.28 | 35.01 | 29.36 | 1.01 |
| Reach 1 | 66865 | 220 | 503.7 | 506.45 | 505.53 | 506.81 | 0.006379 | 4.83 | 45.55 | 17.87 | 0.53 |
| Reach 1 | 66850 | 220 | 503 | 506.48 | 505.29 | 506.7 | 0.003532 | 3.74 | 58.76 | 24.97 | 0.43 |
| Reach 1 | 66796 | 220 | 504 | 505.57 | 505.57 | 506.27 | 0.022159 | 6.69 | 32.88 | 23.77 | 1 |
| Reach 1 | 66396 | 220 | 494 | 496.23 | 496.28 | 497.02 | 0.024083 | 7.16 | 30.75 | 21.6 | 1.06 |
| Reach 1 | 66246 | 220 | 488 | 491.59 | 490.93 | 491.95 | 0.008174 | 4.8 | 45.85 | 25.52 | 0.63 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 220 | 488 | 490.81 | 490.81 | 491.57 | 0.02271 | 6.98 | 31.5 | 21.16 | 1.01 |
| Reach 1 | 66096 | 220 | 484.5 | 486.31 | 486.65 | 487.43 | 0.057089 | 8.5 | 25.9 | 27.38 | 1.54 |
| Reach 1 | 65796 | 220 | 476 | 477.61 | 477.61 | 478.25 | 0.022146 | 6.46 | 34.07 | 26.44 | 1 |
| Reach 1 | 65196 | 220 | 466 | 467.75 | 467.39 | 468.07 | 0.010166 | 4.59 | 47.89 | 34.85 | 0.69 |
| Reach 1 | 64596 | 220 | 454 | 457.53 | 457.53 | 458.78 | 0.025735 | 8.98 | 24.49 | 9.88 | 1.01 |
| Reach 1 | 63996 | 220 | 442 | 444.69 | 444.56 | 445.45 | 0.017645 | 6.97 | 31.58 | 17.45 | 0.91 |
| Reach 1 | 63696 | 220 | 436 | 438.74 | 438.74 | 439.59 | 0.021603 | 7.42 | 29.66 | 17.68 | 1.01 |
| Reach 1 | 63620 | 220 | 434.1 | 436.97 | 435.92 | 437.23 | 0.004501 | 4.13 | 53.31 | 22.62 | 0.47 |
| Reach 1 | 63596 | 220 | 433.7 | 436.97 | | 437.12 | 0.002358 | 3.07 | 71.61 | 28.96 | 0.34 |
| Reach 1 | 63396 | 220 | 432 | 434.87 | 434.87 | 435.94 | 0.023513 | 8.32 | 26.44 | 12.45 | 1.01 |
| Reach 1 | 62796 | 220 | 416.47 | 418.95 | 419.1 | 419.96 | 0.03034 | 8.05 | 27.31 | 17.62 | 1.14 |
| Reach 1 | 62690 | 220 | 415.18 | 417.08 | 416.84 | 417.68 | 0.015729 | 6.22 | 35.37 | 19.56 | 0.82 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 220 | 414.14 | 416.14 | 416.14 | 416.93 | 0.025673 | 7.13 | 30.87 | 19.95 | 1.01 |
| Reach 1 | 62631 | 220 | 411.86 | 413.88 | 414.42 | 415.55 | 0.080265 | 10.37 | 21.21 | 21.29 | 1.83 |
| Reach 1 | 62596 | 220 | 411 | 413.05 | 413.12 | 413.77 | 0.026633 | 6.82 | 32.24 | 26.38 | 1.09 |
| Reach 1 | 62096 | 220 | 404 | 405.98 | 405.67 | 406.24 | 0.010978 | 4.17 | 52.81 | 47.48 | 0.7 |
| Reach 1 | 61696 | 220 | 398 | 400.3 | 400.1 | 400.85 | 0.016746 | 5.97 | 36.83 | 25.73 | 0.88 |
| Reach 1 | 61396 | 220 | 394 | 396.67 | 396.16 | 397.11 | 0.009473 | 5.34 | 41.22 | 21.9 | 0.69 |
| Reach 1 | 60896 | 220 | 386.5 | 389.45 | 389.45 | 390.18 | 0.021972 | 6.87 | 32 | 21.85 | 1 |
| Reach 1 | 60396 | 220 | 379.6 | 382.63 | 381.26 | 382.74 | 0.002009 | 2.69 | 81.88 | 39.21 | 0.33 |
| Reach 1 | 59796 | 220 | 377.4 | 379.48 | 379.41 | 379.93 | 0.020156 | 5.35 | 41.1 | 39.94 | 0.93 |
| Reach 1 | 59500 | 220 | 371.24 | 372.97 | 372.97 | 373.64 | 0.022216 | 6.56 | 33.54 | 25.34 | 1 |
| Reach 1 | 59396 | 220 | 368.2 | 369.71 | 369.9 | 370.4 | 0.046651 | 6.65 | 33.08 | 43.72 | 1.35 |
| Reach 1 | 59300 | 220 | 364.3 | 366.58 | 366.61 | 367.27 | 0.024011 | 6.68 | 32.93 | 25.88 | 1.04 |
| Reach 1 | 59100 | 220 | 360.3 | 362.88 | 362.48 | 363.17 | 0.008819 | 4.31 | 51.06 | 36.76 | 0.64 |
| Reach 1 | 59096 | 220 | 360.2 | 362.39 | 362.33 | 363.08 | 0.019493 | 6.65 | 33.06 | 21.66 | 0.95 |
| Reach 1 | 59036 | 220 | 359 | 362.01 | 361.3 | 362.34 | 0.006568 | 4.62 | 47.62 | 23.89 | 0.58 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 220 | 359 | 361.49 | 361.17 | 362.01 | 0.012076 | 5.77 | 38.13 | 21.41 | 0.76 |
| Reach 1 | 58911 | 220 | 359 | 360.49 | 360.3 | 360.81 | 0.013592 | 4.56 | 48.2 | 43.97 | 0.77 |
| Reach 1 | 58909 | 220 | 359 | 360.3 | 360.3 | 360.77 | 0.024841 | 5.5 | 40.01 | 43.54 | 1.01 |
| Reach 1 | 58908 | 220 | 356 | 356.63 | 357.31 | 360.37 | 0.52999 | 15.53 | 14.16 | 32.41 | 4.14 |
| Reach 1 | 58822 | 220 | 356 | 357.77 | 357.31 | 358.03 | 0.007461 | 4.07 | 54.09 | 37.23 | 0.59 |
| Reach 1 | 58809 | 220 | 356 | 357.31 | 357.31 | 357.85 | 0.023653 | 5.89 | 37.38 | 35.3 | 1.01 |
| Reach 1 | 58808 | 220 | 353 | 356.18 | 354.55 | 356.23 | 0.000894 | 1.88 | 116.96 | 52.18 | 0.22 |
| Reach 1 | 58733 | 220 | 353 | 356.1 | | 356.16 | 0.000989 | 1.95 | 113.08 | 51.74 | 0.23 |

## Alt. 3 (Q = 220)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 58708 | 220 | 353.05 | 356.08 | | 356.14 | 0.000832 | 1.95 | 112.92 | 41.39 | 0.21 |
| Reach 1 | 58658 | 220 | 353.45 | 355.55 | | 355.99 | 0.012726 | 5.36 | 41.06 | 27.87 | 0.78 |
| Reach 1 | 58608 | 220 | 352.81 | 354.94 | | 355.35 | 0.0121 | 5.18 | 42.43 | 29.17 | 0.76 |
| Reach 1 | 58508 | 220 | 351.32 | 353.82 | | 354.15 | 0.011345 | 4.59 | 47.91 | 37.41 | 0.72 |
| Reach 1 | 58308 | 220 | 349.09 | 351.74 | 351.22 | 352.14 | 0.008869 | 5.06 | 43.49 | 23.85 | 0.66 |
| Reach 1 | 58108 | 220 | 346.97 | 348.78 | 348.78 | 349.45 | 0.02203 | 6.6 | 33.31 | 24.86 | 1.01 |
| Reach 1 | 57975 | 220 | 345.1 | 347.87 | 346.8 | 348.13 | 0.004248 | 4.08 | 53.91 | 21.89 | 0.46 |
| Reach 1 | 57804 | 220 | 343.8 | 347.26 | | 347.36 | 0.00419 | 2.58 | 85.17 | 31.34 | 0.28 |
| Reach 1 | 57619 | 220 | 342.5 | 346.74 | | 346.81 | 0.002112 | 2.04 | 107.73 | 33.39 | 0.2 |
| Reach 1 | 57558 | 220 | 341.78 | 346.54 | | 346.64 | 0.003313 | 2.56 | 85.78 | 25.4 | 0.25 |
| Reach 1 | 57509 | 220 | 341.9 | 346.46 | | 346.51 | 0.001472 | 1.82 | 120.93 | 33.38 | 0.17 |
| Reach 1 | 57388 | 220 | 340.6 | 345.94 | | 345.97 | 0.061413 | 1.34 | 164.2 | 35.55 | 0.11 |
| Reach 1 | 57188 | 220 | 339.1 | 341.74 | | 341.91 | 0.009836 | 3.38 | 65.06 | 30.63 | 0.41 |
| Reach 1 | 57058 | 220 | 337.19 | 340.04 | | 340.33 | 0.014846 | 4.3 | 51.12 | 21.68 | 0.49 |
| Reach 1 | 56979 | 220 | 336.3 | 339.21 | 337.9 | 339.39 | 0.008654 | 3.41 | 64.54 | 26.76 | 0.39 |
| Reach 1 | 56776 | 220 | 334.1 | 336.67 | | 336.97 | 0.016915 | 4.4 | 49.96 | 23.14 | 0.53 |
| Reach 1 | 56731 | 220 | 334 | 336.04 | 335.67 | 336.6 | 0.00331 | 6.01 | 36.63 | 17.95 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 220 | 333.3 | 334.97 | 334.97 | 335.81 | 0.006224 | 7.36 | 29.89 | 17.94 | 1 |
| Reach 1 | 56670 | 220 | 331.8 | 332.79 | 333.36 | 334.73 | 0.321584 | 11.19 | 19.66 | 21.29 | 2.05 |
| Reach 1 | 56625 | 220 | 330.4 | 333.62 | 331.92 | 333.77 | 0.00575 | 3.02 | 72.79 | 25.15 | 0.31 |
| Reach 1 | 56596 | 220 | 328.97 | 333.48 | | 333.62 | 0.004426 | 2.94 | 74.93 | 20.8 | 0.27 |
| Reach 1 | 56574 | 220 | 329.8 | 333.26 | | 333.46 | 0.00841 | 3.62 | 60.78 | 21.14 | 0.38 |
| Reach 1 | 56474 | 220 | 329 | 332.39 | 330.87 | 332.6 | 0.008901 | 3.68 | 59.73 | 21.19 | 0.39 |
| Reach 1 | 56275 | 220 | 327.3 | 330.18 | | 330.44 | 0.013453 | 4.06 | 54.25 | 23.16 | 0.47 |
| Reach 1 | 56200 | 220 | 326.4 | 329.95 | | 330.01 | 0.002161 | 2.01 | 109.34 | 34.8 | 0.2 |
| Reach 1 | 56100 | 220 | 326 | 329.61 | | 329.71 | 0.003886 | 2.6 | 84.53 | 27.95 | 0.26 |
| Reach 1 | 56074 | 220 | 325.18 | 329.34 | | 329.54 | 0.008081 | 3.65 | 60.23 | 18.75 | 0.36 |
| Reach 1 | 56058 | 220 | 325.18 | 329.16 | | 329.39 | 0.00942 | 3.86 | 57.02 | 18.4 | 0.39 |
| Reach 1 | 56000 | 220 | 325.7 | 328.59 | | 328.81 | 0.01075 | 3.77 | 58.31 | 23.94 | 0.43 |
| Reach 1 | 55902 | 220 | 323.9 | 327.75 | | 327.94 | 0.007229 | 3.47 | 63.43 | 20.8 | 0.35 |
| Reach 1 | 55872 | 220 | 323.8 | 327.46 | | 327.68 | 0.009534 | 3.79 | 58 | 21.18 | 0.4 |
| Reach 1 | 55800 | 220 | 323.4 | 326.7 | | 326.94 | 0.011173 | 3.93 | 56 | 21.38 | 0.43 |
| Reach 1 | 55706 | 220 | 322.4 | 325.42 | | 325.72 | 0.014567 | 4.35 | 50.55 | 20.75 | 0.49 |
| Reach 1 | 55606 | 220 | 320.3 | 324.7 | | 324.85 | 0.005005 | 3.07 | 71.75 | 21.43 | 0.3 |
| Reach 1 | 55558 | 220 | 321.08 | 323.72 | | 324.25 | 0.030786 | 5.84 | 37.68 | 15.69 | 0.66 |
| Reach 1 | 55505 | 220 | 319.6 | 323.53 | | 323.62 | 0.003395 | 2.5 | 87.9 | 26.61 | 0.24 |
| Reach 1 | 55405 | 220 | 319.1 | 322.92 | | 323.11 | 0.007299 | 3.51 | 62.69 | 19.43 | 0.34 |
| Reach 1 | 55306 | 220 | 318.3 | 322.3 | | 322.45 | 0.00577 | 3.14 | 70.14 | 23.22 | 0.32 |
| Reach 1 | 55206 | 220 | 318 | 321.57 | | 321.75 | 0.008538 | 3.4 | 64.76 | 26.46 | 0.38 |
| Reach 1 | 55108 | 220 | 316.46 | 320.48 | | 320.75 | 0.011789 | 4.16 | 52.91 | 17.94 | 0.43 |
| Reach 1 | 55005 | 220 | 316.1 | 319.58 | | 319.76 | 0.007482 | 3.4 | 64.62 | 23.25 | 0.36 |
| Reach 1 | 54905 | 220 | 315.7 | 318.73 | | 318.93 | 0.009 | 3.6 | 61.15 | 22.93 | 0.39 |
| Reach 1 | 54805 | 220 | 314.7 | 318.08 | | 318.22 | 0.005367 | 2.96 | 74.27 | 24.92 | 0.3 |
| Reach 1 | 54705 | 220 | 314.5 | 317.61 | | 317.71 | 0.004431 | 2.53 | 87.02 | 34.9 | 0.28 |
| Reach 1 | 54596 | 220 | 313.25 | 316.46 | | 316.79 | 0.017346 | 4.61 | 47.68 | 20.17 | 0.53 |
| Reach 1 | 54511 | 220 | 312.7 | 315.48 | | 315.85 | 0.025098 | 4.9 | 44.89 | 24.21 | 0.63 |
| Reach 1 | 54496 | 220 | 312.53 | 314.74 | 314.74 | 315.61 | 0.003058 | 7.45 | 29.54 | 17.38 | 1.01 |
| Reach 1 | 54440 | 220 | 311.9 | 314.46 | 314.06 | 315.16 | 0.001998 | 6.74 | 32.65 | 13.78 | 0.77 |
| Reach 1 | 54431 | 220 | 311.9 | 314.44 | 313.98 | 315.14 | 0.002051 | 6.7 | 32.82 | 12.96 | 0.74 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 220 | 311.4 | 313.48 | 313.48 | 314.53 | 0.003758 | 8.23 | 26.75 | 12.87 | 1.01 |
| Reach 1 | 54305 | 220 | 309.9 | 310.84 | 311.46 | 313.01 | 0.408111 | 11.8 | 18.64 | 22.04 | 2.26 |
| Reach 1 | 54296 | 220 | 308.62 | 311.19 | 311.19 | 311.87 | 0.074518 | 6.62 | 33.22 | 24.45 | 1 |

Alt. 4 (Q=1180)

HEC-RAS Plan: alt3 River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 1180 | 566 | 572.72 | 573.88 | 576.26 | 0.05004 | 15.11 | 78.08 | 26.85 | 1.56 |
| Reach 1 | 69496 | 1180 | 562 | 567.18 | 567.52 | 569.27 | 0.023129 | 11.61 | 101.63 | 32.25 | 1.15 |
| Reach 1 | 69196 | 1180 | 558 | 562.31 | 562.22 | 563.62 | 0.015854 | 9.17 | 128.68 | 45.15 | 0.96 |
| Reach 1 | 68696 | 1180 | 550 | 553.92 | 553.92 | 555.27 | 0.017596 | 9.32 | 126.64 | 47.55 | 1.01 |
| Reach 1 | 68396 | 1180 | 542 | 547.73 | 547.95 | 549.37 | 0.021868 | 10.29 | 114.65 | 43.07 | 1.11 |
| Reach 1 | 67796 | 1180 | 524 | 529.41 | 530.48 | 532.68 | 0.035765 | 14.51 | 81.32 | 24.05 | 1.39 |
| Reach 1 | 67396 | 1180 | 516 | 520.24 | 520.35 | 521.6 | 0.020131 | 9.34 | 126.32 | 52.64 | 1.06 |
| Reach 1 | 66996 | 1180 | 508.5 | 513.02 | 513.02 | 514.32 | 0.017431 | 9.17 | 128.71 | 49.36 | 1 |
| Reach 1 | 66865 | 1180 | 503.7 | 508.85 | 509.06 | 511.49 | 0.024842 | 13.03 | 90.59 | 19.65 | 1.07 |
| Reach 1 | 66850 | 1180 | 503 | 509.8 | 508.32 | 510.65 | 0.006115 | 7.38 | 159.96 | 36 | 0.62 |
| Reach 1 | 66796 | 1180 | 504 | 508.36 | 508.36 | 510.04 | 0.017439 | 10.42 | 113.23 | 33.98 | 1.01 |
| Reach 1 | 66396 | 1180 | 494 | 498.47 | 499.1 | 500.78 | 0.031708 | 12.21 | 96.65 | 37.27 | 1.34 |
| Reach 1 | 66246 | 1180 | 488 | 496.41 | 493.83 | 496.71 | 0.002316 | 4.41 | 267.39 | 66.47 | 0.39 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 1180 | 488 | 493.53 | 493.53 | 494.8 | 0.018085 | 9.04 | 130.57 | 51.74 | 1 |
| Reach 1 | 66096 | 1180 | 484.5 | 487.92 | 488.91 | 490.95 | 0.062395 | 13.97 | 84.49 | 45.15 | 1.8 |
| Reach 1 | 65796 | 1180 | 476 | 480.14 | 480.14 | 481.59 | 0.017439 | 9.68 | 121.91 | 42.53 | 1.01 |
| Reach 1 | 65196 | 1180 | 466 | 470.71 | 469.65 | 471.32 | 0.006468 | 6.24 | 189.13 | 61.55 | 0.63 |
| Reach 1 | 64596 | 1180 | 454 | 462.43 | 462.43 | 464.71 | 0.021214 | 12.11 | 97.48 | 21.78 | 1.01 |
| Reach 1 | 63996 | 1180 | 442 | 447.28 | 447.92 | 449.89 | 0.029213 | 12.97 | 90.98 | 28.45 | 1.28 |
| Reach 1 | 63696 | 1180 | 436 | 441.98 | 441.98 | 443.74 | 0.017082 | 10.65 | 110.83 | 31.51 | 1 |
| Reach 1 | 63620 | 1180 | 434.1 | 441.96 | 439.05 | 442.55 | 0.003268 | 6.17 | 191.27 | 30.55 | 0.43 |
| Reach 1 | 63596 | 1180 | 433.7 | 442.02 | | 442.43 | 0.002105 | 5.14 | 229.74 | 33.71 | 0.35 |
| Reach 1 | 63396 | 1180 | 432 | 439.02 | 439.02 | 441.29 | 0.020075 | 12.1 | 97.54 | 21.79 | 1.01 |
| Reach 1 | 62796 | 1180 | 416.47 | 421.75 | 422.66 | 425.18 | 0.037094 | 14.86 | 79.41 | 20.68 | 1.34 |
| Reach 1 | 62690 | 1180 | 415.18 | 420.52 | 420.11 | 422.57 | 0.018313 | 11.48 | 102.82 | 19.65 | 0.88 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 1180 | 414.14 | 419.37 | 419.37 | 421.73 | 0.023588 | 12.35 | 95.57 | 20.19 | 1 |
| Reach 1 | 62631 | 1180 | 411.86 | 415.5 | 416.86 | 420.22 | 0.089783 | 17.43 | 67.71 | 33.43 | 2.16 |
| Reach 1 | 62596 | 1180 | 411 | 414.77 | 415.57 | 417.56 | 0.042249 | 13.4 | 88.07 | 36.31 | 1.52 |
| Reach 1 | 62096 | 1180 | 404 | 407.56 | 407.49 | 408.43 | 0.017868 | 7.45 | 158.35 | 85.51 | 0.97 |
| Reach 1 | 61696 | 1180 | 398 | 403.24 | | 403.86 | 0.0077 | 6.32 | 186.7 | 67.65 | 0.67 |
| Reach 1 | 61396 | 1180 | 394 | 399.75 | | 401 | 0.011566 | 8.97 | 131.58 | 36.78 | 0.84 |
| Reach 1 | 60896 | 1180 | 386.5 | 392.28 | 392.28 | 393.93 | 0.017423 | 10.33 | 114.27 | 34.65 | 1 |
| Reach 1 | 60396 | 1180 | 379.6 | 385.8 | 383.67 | 386.16 | 0.002895 | 4.86 | 242.64 | 62.32 | 0.43 |
| Reach 1 | 59796 | 1180 | 377.4 | 381.31 | 381.31 | 382.54 | 0.017921 | 8.92 | 132.3 | 53.93 | 1 |
| Reach 1 | 59500 | 1180 | 371.24 | 375.13 | 375.28 | 376.23 | 0.025499 | 8.44 | 139.79 | 80.59 | 1.13 |
| Reach 1 | 59396 | 1180 | 368.2 | 374.78 | 371.61 | 374.93 | 0.000926 | 3.03 | 391.24 | 91.74 | 0.25 |
| Reach 1 | 59300 | 1180 | 369.28 | 374.13 | 373.13 | 374.69 | 0.005916 | 6.03 | 195.81 | 61.67 | 0.6 |
| Reach 1 | 59100 | 1180 | 367.57 | 371.51 | 371.51 | 372.7 | 0.018598 | 8.74 | 135.02 | 56.97 | 1 |
| Reach 1 | 59096 | 1180 | 366.8 | 369.75 | 370.54 | 372.44 | 0.045016 | 13.16 | 89.68 | 40.63 | 1.56 |
| Reach 1 | 59092 | 1180 | 365.61 | 368.79 | 369.86 | 372.18 | 0.055596 | 14.78 | 79.85 | 35.32 | 1.73 |
| Reach 1 | 59036 | 1180 | 365.06 | 369.33 | 368.6 | 370.53 | 0.010916 | 8.78 | 134.32 | 32.16 | 0.76 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 1180 | 364.7 | 368.25 | 368.25 | 370.01 | 0.01967 | 10.65 | 110.79 | 31.75 | 1 |
| Reach 1 | 58911 | 1180 | 363.78 | 367.59 | 367.06 | 368.48 | 0.010161 | 7.59 | 155.45 | 52.67 | 0.78 |
| Reach 1 | 58822 | 1180 | 362.9 | 366.29 | | 367.4 | 0.014125 | 8.44 | 139.83 | 51.86 | 0.91 |
| Reach 1 | 58733 | 1180 | 362.03 | 365.87 | 364.97 | 366.44 | 0.006204 | 6.04 | 195.31 | 63.86 | 0.61 |
| Reach 1 | 58730 | 1180 | 362 | 364.9 | 364.9 | 366.33 | 0.017753 | 9.65 | 124.93 | 44.83 | 1 |
| Reach 1 | 58708 | 1180 | 353.05 | 354.47 | 356.27 | 364.41 | 0.413931 | 25.29 | 46.65 | 41.22 | 4.19 |
| Reach 1 | 58658 | 1180 | 353.45 | 357.6 | 357.76 | 359.16 | 0.020421 | 10 | 117.94 | 44.38 | 1.08 |
| Reach 1 | 58608 | 1180 | 352.81 | 357.35 | 357.09 | 358.39 | 0.013487 | 8.19 | 144.11 | 53.86 | 0.88 |
| Reach 1 | 58508 | 1180 | 351.32 | 356.9 | | 357.47 | 0.005066 | 6.07 | 194.56 | 53.51 | 0.56 |
| Reach 1 | 58308 | 1180 | 349.09 | 354.52 | 354.14 | 355.87 | 0.012643 | 9.31 | 126.79 | 35.35 | 0.87 |
| Reach 1 | 58108 | 1180 | 346.97 | 353.5 | | 354.12 | 0.005144 | 6.32 | 186.69 | 47.31 | 0.56 |
| Reach 1 | 57975 | 1180 | 345.1 | 352.96 | | 353.53 | 0.003674 | 6.07 | 194.38 | 37.02 | 0.47 |
| Reach 1 | 57804 | 1180 | 343.8 | 352.59 | | 352.82 | 0.003414 | 3.83 | 307.85 | 52.39 | 0.28 |
| Reach 1 | 57619 | 1180 | 342.5 | 352.06 | | 352.25 | 0.00259 | 3.5 | 337.28 | 52.94 | 0.24 |
| Reach 1 | 57558 | 1180 | 341.78 | 351.67 | | 352 | 0.004871 | 4.62 | 255.67 | 40.4 | 0.32 |
| Reach 1 | 57509 | 1180 | 341.9 | 351.56 | | 351.76 | 0.00258 | 3.58 | 329.17 | 48.21 | 0.24 |
| Reach 1 | 57388 | 1180 | 340.6 | 350.64 | | 350.74 | 0.152379 | 2.56 | 461.55 | 77.46 | 0.18 |

Alt. 4 (Q=1180)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 57188 | 1180 | 339.1 | 345.98 | | 346.4 | 0.007999 | 5.25 | 224.95 | 45.34 | 0.42 |
| Reach 1 | 57058 | 1180 | 337.19 | 344.41 | | 345.03 | 0.013059 | 6.34 | 186.1 | 39.8 | 0.52 |
| Reach 1 | 56979 | 1180 | 336.3 | 343.68 | | 344.14 | 0.00827 | 5.47 | 215.56 | 40.82 | 0.42 |
| Reach 1 | 56776 | 1180 | 334.1 | 342.04 | | 342.51 | 0.007891 | 5.47 | 215.72 | 38.53 | 0.41 |
| Reach 1 | 56731 | 1180 | 334 | 339.38 | 339.13 | 341.7 | 0.004065 | 12.23 | 96.7 | 18.03 | 0.93 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 1180 | 333.3 | 338.42 | 338.42 | 340.98 | 0.006143 | 12.83 | 92.01 | 18.02 | 1 |
| Reach 1 | 56670 | 1180 | 331.8 | 339.22 | 336.26 | 339.7 | 0.008226 | 5.54 | 213.15 | 38.85 | 0.42 |
| Reach 1 | 56625 | 1180 | 330.4 | 338.93 | | 339.35 | 0.00614 | 5.16 | 228.85 | 33.64 | 0.35 |
| Reach 1 | 56596 | 1180 | 328.97 | 338.54 | | 339.1 | 0.008542 | 5.96 | 197.95 | 27.81 | 0.39 |
| Reach 1 | 56574 | 1180 | 329.8 | 338.32 | | 338.89 | 0.009497 | 6.08 | 194.14 | 31.58 | 0.43 |
| Reach 1 | 56474 | 1180 | 329 | 337.29 | | 337.9 | 0.010308 | 6.25 | 188.92 | 31.57 | 0.45 |
| Reach 1 | 56275 | 1180 | 327.3 | 335.41 | | 335.95 | 0.009027 | 5.92 | 199.33 | 32.37 | 0.42 |
| Reach 1 | 56200 | 1180 | 326.4 | 335.24 | | 335.45 | 0.002662 | 3.67 | 324.62 | 61.6 | 0.24 |
| Reach 1 | 56100 | 1180 | 326 | 334.93 | | 335.14 | 0.003416 | 3.91 | 331.78 | 98.51 | 0.27 |
| Reach 1 | 56074 | 1180 | 325.18 | 334.13 | | 334.84 | 0.012385 | 6.78 | 175.45 | 34.59 | 0.48 |
| Reach 1 | 56058 | 1180 | 325.18 | 333.8 | | 334.6 | 0.01463 | 7.17 | 164.83 | 30.37 | 0.52 |
| Reach 1 | 56000 | 1180 | 325.7 | 333.44 | | 333.82 | 0.007062 | 5.13 | 275.37 | 167.57 | 0.38 |
| Reach 1 | 55902 | 1180 | 323.9 | 333.02 | | 333.2 | 0.004139 | 3.8 | 375.19 | 180.06 | 0.29 |
| Reach 1 | 55872 | 1180 | 323.8 | 332.28 | | 332.87 | 0.010699 | 6.2 | 190.37 | 34.62 | 0.47 |
| Reach 1 | 55800 | 1180 | 323.4 | 331.53 | | 332.1 | 0.010709 | 6.1 | 205.28 | 100.42 | 0.46 |
| Reach 1 | 55706 | 1180 | 322.4 | 330.79 | | 331.19 | 0.007264 | 5.29 | 261.37 | 139.16 | 0.39 |
| Reach 1 | 55606 | 1180 | 320.3 | 330.34 | | 330.58 | 0.004134 | 4.22 | 332.21 | 147.79 | 0.29 |
| Reach 1 | 55558 | 1180 | 321.08 | 328.53 | | 329.85 | 0.025807 | 9.23 | 129.63 | 25.95 | 0.65 |
| Reach 1 | 55505 | 1180 | 319.6 | 328.62 | | 328.87 | 0.00399 | 4.18 | 314.68 | 97.84 | 0.28 |
| Reach 1 | 55405 | 1180 | 319.1 | 327.68 | | 328.19 | 0.009961 | 6 | 220.81 | 82.17 | 0.42 |
| Reach 1 | 55306 | 1180 | 318.3 | 326.9 | | 327.21 | 0.008021 | 4.75 | 274.96 | 115.81 | 0.4 |
| Reach 1 | 55206 | 1180 | 318 | 326.33 | | 326.53 | 0.005105 | 3.84 | 330.61 | 119.57 | 0.32 |
| Reach 1 | 55108 | 1180 | 316.46 | 324.58 | | 325.45 | 0.01945 | 7.6 | 162.03 | 43.76 | 0.6 |
| Reach 1 | 55005 | 1180 | 316.1 | 323.98 | | 324.19 | 0.005261 | 3.93 | 324.79 | 125.54 | 0.32 |
| Reach 1 | 54905 | 1180 | 315.7 | 323.39 | | 323.6 | 0.006511 | 3.93 | 327.84 | 148.16 | 0.35 |
| Reach 1 | 54805 | 1180 | 314.7 | 323.02 | | 323.13 | 0.002954 | 2.62 | 443.2 | 159.29 | 0.24 |
| Reach 1 | 54705 | 1180 | 314.5 | 322.85 | | 322.93 | 0.001315 | 2.53 | 563.31 | 240 | 0.18 |
| Reach 1 | 54596 | 1180 | 313.25 | 322.16 | | 322.56 | 0.00605 | 5.26 | 241.06 | 58.91 | 0.36 |
| Reach 1 | 54511 | 1180 | 312.7 | 322.27 | | 322.31 | 0.000689 | 1.72 | 745.48 | 215 | 0.13 |
| Reach 1 | 54496 | 1180 | 312.53 | 321.9 | | 322.22 | 0.000195 | 4.84 | 403.37 | 105.45 | 0.31 |
| Reach 1 | 54440 | 1180 | 311.9 | 322.01 | | 322.1 | 0.000126 | 3.49 | 1084.65 | 400 | 0.2 |
| Reach 1 | 54431 | 1180 | 311.9 | 322.02 | 318.28 | 322.07 | 0.000126 | 2.97 | 1522.92 | 790 | 0.17 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 1180 | 311.4 | 317.78 | 317.78 | 320.97 | 0.004401 | 14.33 | 82.33 | 13.02 | 1 |
| Reach 1 | 54305 | 1180 | 309.9 | 312.48 | 314.31 | 318.63 | 0.35638 | 19.9 | 59.29 | 27.5 | 2.39 |
| Reach 1 | 54296 | 1180 | 308.62 | 313.97 | 313.97 | 315.65 | 0.059007 | 10.4 | 113.45 | 33.79 | 1 |

Alt. 4 (220 cfs)

HEC-RAS Plan: alt4_220 River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 220 | 566 | 569.04 | 569.59 | 571.1 | 0.050013 | 11.52 | 19.1 | 8.56 | 1.36 |
| Reach 1 | 69496 | 220 | 562 | 564.52 | 564.36 | 565.21 | 0.016708 | 6.64 | 33.14 | 19.29 | 0.89 |
| Reach 1 | 69196 | 220 | 558 | 560.01 | 559.8 | 560.46 | 0.014558 | 5.34 | 41.17 | 30.87 | 0.82 |
| Reach 1 | 68696 | 220 | 550 | 551.54 | 551.47 | 552.1 | 0.019316 | 6 | 36.64 | 28.68 | 0.94 |
| Reach 1 | 68396 | 220 | 542 | 545.18 | 545.18 | 545.92 | 0.0219 | 6.88 | 31.98 | 21.84 | 1 |
| Reach 1 | 67796 | 220 | 524 | 526.25 | 526.68 | 527.81 | 0.043695 | 10.05 | 21.9 | 13.49 | 1.39 |
| Reach 1 | 67396 | 220 | 516 | 518.08 | 517.88 | 518.57 | 0.014827 | 5.61 | 39.23 | 27.93 | 0.83 |
| Reach 1 | 66996 | 220 | 508.5 | 510.64 | 510.64 | 511.25 | 0.022993 | 6.28 | 35.01 | 29.36 | 1.01 |
| Reach 1 | 66865 | 220 | 503.7 | 506.45 | 505.53 | 506.81 | 0.006379 | 4.83 | 45.55 | 17.87 | 0.53 |
| Reach 1 | 66850 | 220 | 503 | 506.48 | 505.29 | 506.7 | 0.003532 | 3.74 | 58.76 | 24.97 | 0.43 |
| Reach 1 | 66796 | 220 | 504 | 505.57 | 505.57 | 506.27 | 0.022159 | 6.69 | 32.88 | 23.77 | 1 |
| Reach 1 | 66396 | 220 | 494 | 496.23 | 496.28 | 497.02 | 0.024083 | 7.16 | 30.75 | 21.6 | 1.06 |
| Reach 1 | 66246 | 220 | 488 | 491.59 | 490.93 | 491.95 | 0.008174 | 4.8 | 45.85 | 25.52 | 0.63 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 220 | 488 | 490.81 | 490.81 | 491.57 | 0.02271 | 6.98 | 31.5 | 21.16 | 1.01 |
| Reach 1 | 66096 | 220 | 484.5 | 486.31 | 486.65 | 487.43 | 0.057089 | 8.5 | 25.9 | 27.38 | 1.54 |
| Reach 1 | 65796 | 220 | 476 | 477.61 | 477.61 | 478.25 | 0.022146 | 6.46 | 34.07 | 26.44 | 1 |
| Reach 1 | 65196 | 220 | 466 | 467.75 | 467.39 | 468.07 | 0.010166 | 4.59 | 47.89 | 34.85 | 0.69 |
| Reach 1 | 64596 | 220 | 454 | 457.53 | 457.53 | 458.78 | 0.025735 | 8.98 | 24.49 | 9.88 | 1.01 |
| Reach 1 | 63996 | 220 | 442 | 444.69 | 444.56 | 445.45 | 0.017645 | 6.97 | 31.58 | 17.45 | 0.91 |
| Reach 1 | 63696 | 220 | 436 | 438.74 | 438.74 | 439.59 | 0.021603 | 7.42 | 29.66 | 17.68 | 1.01 |
| Reach 1 | 63620 | 220 | 434.1 | 436.97 | 435.92 | 437.23 | 0.004501 | 4.13 | 53.31 | 22.62 | 0.47 |
| Reach 1 | 63596 | 220 | 433.7 | 436.97 | | 437.12 | 0.002358 | 3.07 | 71.61 | 28.96 | 0.34 |
| Reach 1 | 63396 | 220 | 432 | 434.87 | 434.87 | 435.94 | 0.023513 | 8.32 | 26.44 | 12.45 | 1.01 |
| Reach 1 | 62796 | 220 | 416.47 | 418.95 | 419.1 | 419.96 | 0.03034 | 8.05 | 27.31 | 17.62 | 1.14 |
| Reach 1 | 62690 | 220 | 415.18 | 417.08 | 416.84 | 417.68 | 0.015729 | 6.22 | 35.37 | 19.56 | 0.82 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 220 | 414.14 | 416.14 | 416.14 | 416.93 | 0.025673 | 7.13 | 30.87 | 19.95 | 1.01 |
| Reach 1 | 62631 | 220 | 411.86 | 413.88 | 414.42 | 415.55 | 0.080265 | 10.37 | 21.21 | 21.29 | 1.83 |
| Reach 1 | 62596 | 220 | 411 | 413.05 | 413.12 | 413.77 | 0.026633 | 6.82 | 32.24 | 26.38 | 1.09 |
| Reach 1 | 62096 | 220 | 404 | 405.98 | 405.67 | 406.24 | 0.010978 | 4.17 | 52.81 | 47.48 | 0.7 |
| Reach 1 | 61696 | 220 | 398 | 400.3 | 400.1 | 400.85 | 0.016746 | 5.97 | 36.83 | 25.73 | 0.88 |
| Reach 1 | 61396 | 220 | 394 | 396.67 | 396.16 | 397.11 | 0.009473 | 5.34 | 41.22 | 21.9 | 0.69 |
| Reach 1 | 60896 | 220 | 386.5 | 389.45 | 389.45 | 390.18 | 0.021972 | 6.87 | 32 | 21.85 | 1 |
| Reach 1 | 60396 | 220 | 379.6 | 382.63 | 381.26 | 382.74 | 0.002009 | 2.69 | 81.88 | 39.21 | 0.33 |
| Reach 1 | 59796 | 220 | 377.4 | 379.48 | 379.41 | 379.93 | 0.020145 | 5.35 | 41.1 | 39.94 | 0.93 |
| Reach 1 | 59500 | 220 | 371.24 | 372.97 | 372.97 | 373.64 | 0.022216 | 6.56 | 33.54 | 25.34 | 1 |
| Reach 1 | 59396 | 220 | 368.2 | 372.09 | 369.9 | 372.12 | 0.000346 | 1.26 | 173.99 | 69.53 | 0.14 |
| Reach 1 | 59300 | 220 | 369.28 | 371.85 | | 372.02 | 0.004705 | 3.33 | 66.15 | 43.31 | 0.47 |
| Reach 1 | 59100 | 220 | 367.57 | 369.63 | 369.63 | 370.15 | 0.025255 | 5.77 | 38.1 | 38.13 | 1.02 |
| Reach 1 | 59096 | 220 | 366.8 | 367.73 | 368.3 | 369.79 | 0.15508 | 11.52 | 19.09 | 27.15 | 2.42 |
| Reach 1 | 59092 | 220 | 365.61 | 366.6 | 367.3 | 369.12 | 0.15661 | 12.76 | 17.24 | 21.01 | 2.48 |
| Reach 1 | 59036 | 220 | 365.06 | 366.6 | 366.22 | 366.93 | 0.009864 | 4.63 | 47.54 | 31.22 | 0.66 |
| Reach 1 | 59035 | Bridge | | | | | | | | | |
| Reach 1 | 59000 | 220 | 364.7 | 366.19 | | 366.54 | 0.010944 | 4.78 | 46 | 31.11 | 0.69 |
| Reach 1 | 58911 | 220 | 363.78 | 365.21 | | 365.54 | 0.011375 | 4.59 | 47.9 | 37.92 | 0.72 |
| Reach 1 | 58822 | 220 | 362.9 | 364.47 | 364.02 | 364.71 | 0.007392 | 3.93 | 55.95 | 40.47 | 0.59 |
| Reach 1 | 58733 | 220 | 362.03 | 363.12 | 363.12 | 363.6 | 0.024354 | 5.51 | 39.9 | 42.8 | 1.01 |
| Reach 1 | 58730 | 220 | 362 | 362.8 | 362.95 | 363.48 | 0.044549 | 6.66 | 33.25 | 42.23 | 1.32 |
| Reach 1 | 58708 | 220 | 353.05 | 356.08 | 354.29 | 356.14 | 0.000832 | 1.95 | 112.92 | 41.39 | 0.21 |
| Reach 1 | 58658 | 220 | 353.45 | 355.55 | | 355.99 | 0.012726 | 5.36 | 41.06 | 27.87 | 0.78 |
| Reach 1 | 58608 | 220 | 352.81 | 354.94 | | 355.35 | 0.0121 | 5.18 | 42.43 | 29.17 | 0.76 |
| Reach 1 | 58508 | 220 | 351.32 | 353.82 | | 354.15 | 0.011345 | 4.59 | 47.91 | 37.41 | 0.72 |
| Reach 1 | 58308 | 220 | 349.09 | 351.74 | 351.22 | 352.14 | 0.008869 | 5.06 | 43.49 | 23.85 | 0.66 |
| Reach 1 | 58108 | 220 | 346.97 | 348.78 | 348.78 | 349.45 | 0.02203 | 6.6 | 33.31 | 24.86 | 1.01 |
| Reach 1 | 57975 | 220 | 345.1 | 347.87 | 346.8 | 348.13 | 0.004248 | 4.08 | 53.91 | 21.89 | 0.46 |
| Reach 1 | 57804 | 220 | 343.8 | 347.26 | | 347.36 | 0.00419 | 2.58 | 85.16 | 31.33 | 0.28 |
| Reach 1 | 57619 | 220 | 342.5 | 346.74 | | 346.81 | 0.002113 | 2.04 | 107.72 | 33.39 | 0.2 |
| Reach 1 | 57558 | 220 | 341.78 | 346.54 | | 346.64 | 0.003314 | 2.57 | 85.77 | 25.4 | 0.25 |
| Reach 1 | 57509 | 220 | 341.9 | 346.46 | | 346.51 | 0.001473 | 1.82 | 120.92 | 33.37 | 0.17 |
| Reach 1 | 57388 | 220 | 340.6 | 345.94 | | 345.97 | 0.061438 | 1.34 | 164.18 | 35.55 | 0.11 |
| Reach 1 | 57188 | 220 | 339.1 | 341.74 | | 341.91 | 0.009831 | 3.38 | 65.07 | 30.63 | 0.41 |
| Reach 1 | 57058 | 220 | 337.19 | 340.05 | | 340.33 | 0.014794 | 4.3 | 51.19 | 21.69 | 0.49 |

Alt. 4 (220 cfs)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 56979 | 220 | 336.3 | 339.22 | 337.9 | 339.4 | 0.008559 | 3.4 | 64.79 | 26.79 | 0.38 |
| Reach 1 | 56776 | 220 | 334.1 | 336.63 | | 336.94 | 0.017674 | 4.47 | 49.22 | 23.05 | 0.54 |
| Reach 1 | 56731 | 220 | 334 | 336.04 | 335.67 | 336.6 | 0.002919 | 6.01 | 36.6 | 17.95 | 0.74 |
| Reach 1 | 56730 Bridge | | | | | | | | | | |
| Reach 1 | 56706 | 220 | 333.3 | 334.97 | 334.97 | 335.81 | 0.006224 | 7.36 | 29.89 | 17.94 | 1 |
| Reach 1 | 56670 | 220 | 331.8 | 332.79 | 333.36 | 334.73 | 0.321584 | 11.19 | 19.66 | 21.29 | 2.05 |
| Reach 1 | 56625 | 220 | 330.4 | 333.62 | 331.92 | 333.77 | 0.00575 | 3.02 | 72.79 | 25.15 | 0.31 |
| Reach 1 | 56596 | 220 | 328.97 | 333.48 | | 333.62 | 0.004426 | 2.94 | 74.93 | 20.8 | 0.27 |
| Reach 1 | 56574 | 220 | 329.8 | 333.26 | | 333.46 | 0.00841 | 3.62 | 60.78 | 21.14 | 0.38 |
| Reach 1 | 56474 | 220 | 329 | 332.39 | 330.87 | 332.6 | 0.008901 | 3.68 | 59.73 | 21.19 | 0.39 |
| Reach 1 | 56275 | 220 | 327.3 | 330.18 | | 330.44 | 0.013453 | 4.06 | 54.25 | 23.16 | 0.47 |
| Reach 1 | 56200 | 220 | 326.4 | 329.95 | | 330.01 | 0.002161 | 2.01 | 109.34 | 34.8 | 0.2 |
| Reach 1 | 56100 | 220 | 326 | 329.61 | | 329.71 | 0.003886 | 2.6 | 84.53 | 27.95 | 0.26 |
| Reach 1 | 56074 | 220 | 325.18 | 329.34 | | 329.54 | 0.008081 | 3.65 | 60.23 | 18.75 | 0.36 |
| Reach 1 | 56058 | 220 | 325.18 | 329.16 | | 329.39 | 0.00942 | 3.86 | 57.02 | 18.4 | 0.39 |
| Reach 1 | 56000 | 220 | 325.7 | 328.59 | | 328.81 | 0.01075 | 3.77 | 58.31 | 23.94 | 0.43 |
| Reach 1 | 55902 | 220 | 323.9 | 327.75 | | 327.94 | 0.007229 | 3.47 | 63.43 | 20.8 | 0.35 |
| Reach 1 | 55872 | 220 | 323.8 | 327.46 | | 327.68 | 0.009534 | 3.79 | 58 | 21.18 | 0.4 |
| Reach 1 | 55800 | 220 | 323.4 | 326.7 | | 326.94 | 0.011173 | 3.93 | 56 | 21.38 | 0.43 |
| Reach 1 | 55706 | 220 | 322.4 | 325.42 | | 325.72 | 0.014567 | 4.35 | 50.55 | 20.75 | 0.49 |
| Reach 1 | 55606 | 220 | 320.3 | 324.7 | | 324.85 | 0.005005 | 3.07 | 71.75 | 21.43 | 0.3 |
| Reach 1 | 55558 | 220 | 321.08 | 323.72 | | 324.25 | 0.030786 | 5.84 | 37.68 | 15.69 | 0.66 |
| Reach 1 | 55505 | 220 | 319.6 | 323.53 | | 323.62 | 0.003395 | 2.5 | 87.9 | 26.61 | 0.24 |
| Reach 1 | 55405 | 220 | 319.1 | 322.92 | | 323.11 | 0.007299 | 3.51 | 62.69 | 19.43 | 0.34 |
| Reach 1 | 55306 | 220 | 318.3 | 322.3 | | 322.45 | 0.00577 | 3.14 | 70.14 | 23.22 | 0.32 |
| Reach 1 | 55206 | 220 | 318 | 321.57 | | 321.75 | 0.008538 | 3.4 | 64.76 | 26.46 | 0.38 |
| Reach 1 | 55108 | 220 | 316.46 | 320.48 | | 320.75 | 0.011789 | 4.16 | 52.91 | 17.94 | 0.43 |
| Reach 1 | 55005 | 220 | 316.1 | 319.58 | | 319.76 | 0.007482 | 3.4 | 64.62 | 23.25 | 0.36 |
| Reach 1 | 54905 | 220 | 315.7 | 318.73 | | 318.93 | 0.009 | 3.6 | 61.15 | 22.93 | 0.39 |
| Reach 1 | 54805 | 220 | 314.7 | 318.08 | | 318.22 | 0.005367 | 2.96 | 74.27 | 24.92 | 0.3 |
| Reach 1 | 54705 | 220 | 314.5 | 317.61 | | 317.71 | 0.004431 | 2.53 | 87.02 | 34.9 | 0.28 |
| Reach 1 | 54596 | 220 | 313.25 | 316.46 | | 316.79 | 0.017346 | 4.61 | 47.68 | 20.17 | 0.53 |
| Reach 1 | 54511 | 220 | 312.7 | 315.48 | | 315.85 | 0.025098 | 4.9 | 44.89 | 24.21 | 0.63 |
| Reach 1 | 54496 | 220 | 312.53 | 314.74 | 314.74 | 315.61 | 0.003058 | 7.45 | 29.54 | 17.38 | 1.01 |
| Reach 1 | 54440 | 220 | 311.9 | 314.46 | 314.06 | 315.16 | 0.001998 | 6.74 | 32.65 | 13.78 | 0.77 |
| Reach 1 | 54431 | 220 | 311.9 | 314.44 | 313.98 | 315.14 | 0.002051 | 6.7 | 32.82 | 12.96 | 0.74 |
| Reach 1 | 54430 Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 220 | 311.4 | 313.48 | 313.48 | 314.53 | 0.003758 | 8.23 | 26.75 | 12.87 | 1.01 |
| Reach 1 | 54305 | 220 | 309.9 | 310.84 | 311.46 | 313.01 | 0.408111 | 11.8 | 18.64 | 22.04 | 2.26 |
| Reach 1 | 54296 | 220 | 308.62 | 311.19 | 311.19 | 311.87 | 0.074518 | 6.62 | 33.22 | 24.45 | 1 |

# APPENDIX F.3

## WARDELL ROAD BRIDGE FLOW HEIGHT

# Appendix F.3
# HEC-RAS Evaluation of Wardell Road Flow Height for 11 February 1992

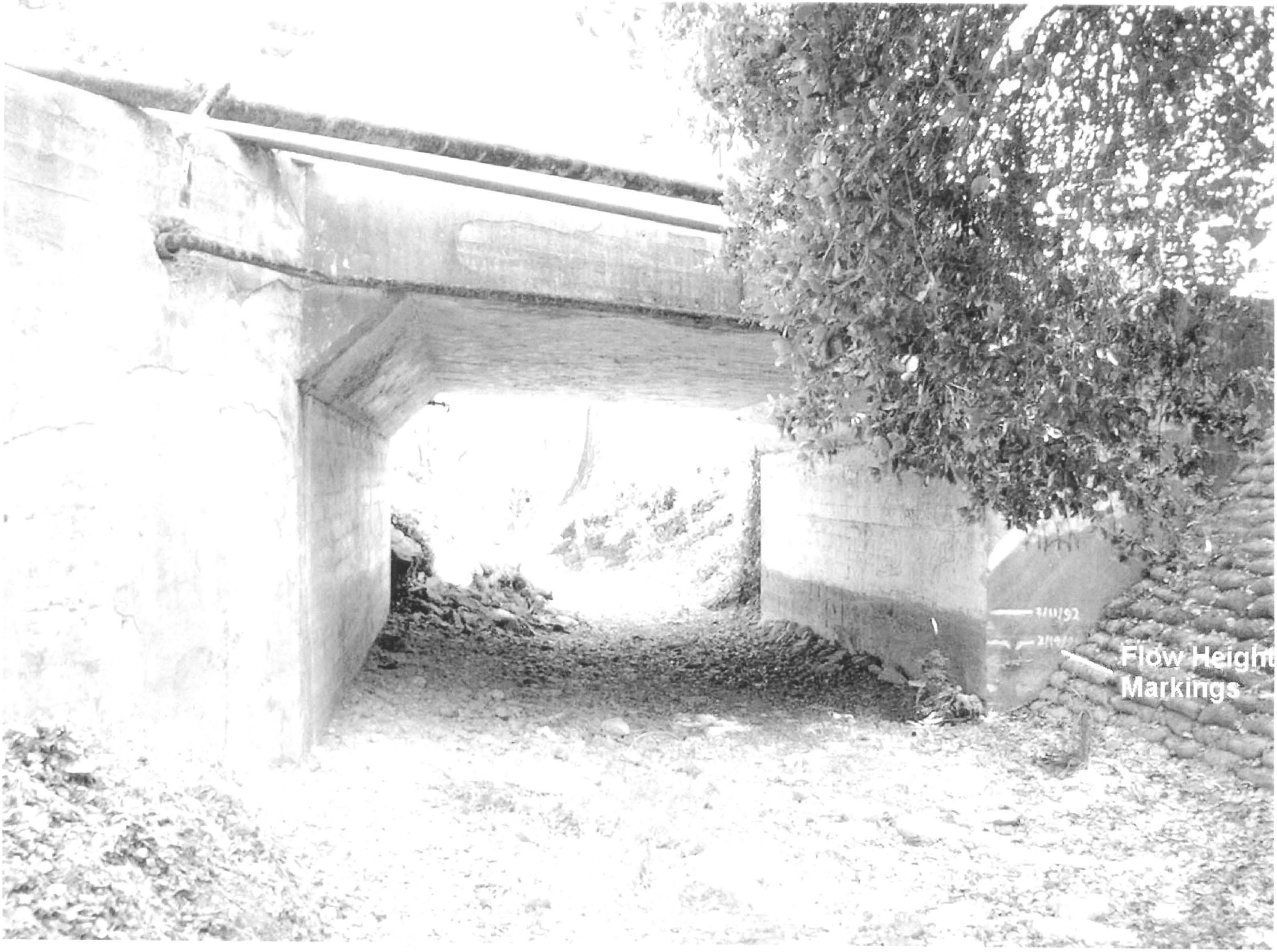
TEST FOR FLOW ELEVATION AT WARDELL ROAD

HEC-RAS Plan: Mixed River: Calabazas Creek Reach: Reach 1 Profile: PF 1

| Reach | River Sta | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 69696 | 778.8 | 566 | 572.78 | 572.78 | 574.26 | 0.020565 | 9.75 | 79.89 | 27.27 | 1 |
| Reach 1 | 69496 | 778.8 | 562 | 565.7 | 566.52 | 568.38 | 0.043143 | 13.15 | 59.24 | 25.03 | 1.51 |
| Reach 1 | 69196 | 778.8 | 558 | 561.6 | 561.4 | 562.58 | 0.014874 | 7.95 | 97.96 | 40.71 | 0.9 |
| Reach 1 | 68696 | 778.8 | 550 | 553.12 | 553.12 | 554.25 | 0.018702 | 8.54 | 91.22 | 40.9 | 1.01 |
| Reach 1 | 68396 | 778.8 | 542 | 546.99 | 547.1 | 548.29 | 0.021056 | 9.16 | 84.98 | 36.88 | 1.06 |
| Reach 1 | 67796 | 778.8 | 524 | 528.34 | 529.18 | 531.2 | 0.0398 | 13.57 | 57.37 | 20.46 | 1.43 |
| Reach 1 | 67396 | 778.8 | 516 | 519.63 | 519.58 | 520.65 | 0.018029 | 8.1 | 96.16 | 45.71 | 0.98 |
| Reach 1 | 66996 | 778.8 | 508.5 | 512.25 | 512.25 | 513.33 | 0.018491 | 8.37 | 93.08 | 42.86 | 1 |
| Reach 1 | 66865 | 778.8 | 503.7 | 507.2 | 507.81 | 509.87 | 0.036486 | 13.1 | 59.46 | 18.48 | 1.29 |
| Reach 1 | 66850 | 778.8 | 503 | 508.73 | 507.3 | 509.35 | 0.005439 | 6.3 | 123.59 | 32.52 | 0.57 |
| Reach 1 | 66796 | 778.8 | 504 | 507.41 | 507.41 | 508.79 | 0.018475 | 9.41 | 82.78 | 30.51 | 1.01 |
| Reach 1 | 66396 | 778.8 | 494 | 497.79 | 498.2 | 499.56 | 0.02935 | 10.67 | 72.97 | 32.52 | 1.26 |
| Reach 1 | 66246 | 778.8 | 488 | 496.17 | 492.96 | 496.31 | 0.001187 | 3.1 | 251.51 | 64.4 | 0.28 |
| Reach 1 | 66245 | Bridge | | | | | | | | | |
| Reach 1 | 66216 | 778.8 | 488 | 492.72 | 492.72 | 493.83 | 0.019567 | 8.46 | 92.07 | 42.55 | 1.01 |
| Reach 1 | 66096 | 778.8 | 484.5 | 487.4 | 488.17 | 489.83 | 0.062672 | 12.52 | 62.22 | 39.36 | 1.75 |
| Reach 1 | 65796 | 778.8 | 476 | 479.31 | 479.31 | 480.51 | 0.01847 | 8.78 | 88.71 | 37.54 | 1.01 |
| Reach 1 | 65196 | 778.8 | 466 | 469.7 | 468.9 | 470.24 | 0.007321 | 5.89 | 132.13 | 51.44 | 0.65 |
| Reach 1 | 64596 | 778.8 | 454 | 460.91 | 460.91 | 462.94 | 0.022681 | 11.45 | 68 | 16.9 | 1.01 |
| Reach 1 | 63996 | 778.8 | 442 | 446.5 | 446.85 | 448.42 | 0.02576 | 11.13 | 69.96 | 25.11 | 1.18 |
| Reach 1 | 63696 | 778.8 | 436 | 440.94 | 440.94 | 442.4 | 0.018004 | 9.69 | 80.37 | 27.59 | 1 |
| Reach 1 | 63620 | 778.8 | 434.1 | 440.32 | 438 | 440.78 | 0.003364 | 5.47 | 142.26 | 29.43 | 0.44 |
| Reach 1 | 63596 | 778.8 | 433.7 | 440.36 | | 440.67 | 0.002002 | 4.44 | 175.22 | 32.15 | 0.34 |
| Reach 1 | 63396 | 778.8 | 432 | 437.68 | 437.68 | 439.58 | 0.020914 | 11.07 | 70.37 | 18.78 | 1.01 |
| Reach 1 | 62796 | 778.8 | 416.47 | 420.75 | 421.4 | 423.39 | 0.035747 | 13.04 | 59.72 | 18.74 | 1.29 |
| Reach 1 | 62690 | 778.8 | 415.18 | 419.3 | 418.93 | 420.82 | 0.017204 | 9.87 | 78.91 | 19.62 | 0.87 |
| Reach 1 | 62689 | Bridge | | | | | | | | | |
| Reach 1 | 62662 | 778.8 | 414.14 | 418.2 | 418.2 | 420.01 | 0.02364 | 10.81 | 72.06 | 20.11 | 1.01 |
| Reach 1 | 62631 | 778.8 | 411.86 | 415 | 416.04 | 418.57 | 0.089081 | 15.15 | 51.42 | 31.55 | 2.09 |
| Reach 1 | 62596 | 778.8 | 411 | 414.27 | 414.75 | 416.17 | 0.036317 | 11.06 | 70.43 | 34.82 | 1.37 |
| Reach 1 | 62096 | 778.8 | 404 | 407.12 | 406.94 | 407.74 | 0.015162 | 6.34 | 122.93 | 74.92 | 0.87 |
| Reach 1 | 61696 | 778.8 | 398 | 402.36 | | 402.92 | 0.009757 | 5.99 | 130.03 | 61.1 | 0.72 |
| Reach 1 | 61396 | 778.8 | 394 | 398.78 | | 399.76 | 0.011096 | 7.93 | 98.21 | 32.1 | 0.8 |
| Reach 1 | 60896 | 778.8 | 386.5 | 391.34 | 391.34 | 392.69 | 0.018356 | 9.31 | 83.65 | 31.11 | 1 |
| Reach 1 | 60396 | 778.8 | 379.6 | 384.81 | 382.88 | 385.09 | 0.002648 | 4.21 | 184.82 | 55.14 | 0.41 |
| Reach 1 | 59796 | 778.8 | 377.4 | 380.68 | 380.68 | 381.64 | 0.019245 | 7.85 | 99.24 | 52.05 | 1 |
| Reach 1 | 59500 | 778.8 | 371.24 | 374.79 | 374.79 | 375.53 | 0.02173 | 6.88 | 113.26 | 78.88 | 1.01 |
| Reach 1 | 59396 | 778.8 | 368.2 | 373.76 | 371.02 | 373.86 | 0.000889 | 2.58 | 301.48 | 83.49 | 0.24 |
| Reach 1 | 59300 | 778.8 | 369.28 | 373.1 | 372.55 | 373.63 | 0.008519 | 5.82 | 133.85 | 58.99 | 0.68 |
| Reach 1 | 59100 | 778.8 | 367.57 | 371.75 | | 372.18 | 0.006009 | 5.24 | 148.63 | 57.77 | 0.58 |
| Reach 1 | 59096 | 778.8 | 366.8 | 371.84 | | 372.12 | 0.002 | 4.27 | 194.73 | 60.88 | 0.37 |
| Reach 1 | 59036 | 778.8 | 366.52 | 371.21 | 370.14 | 371.87 | 0.007022 | 6.54 | 119.12 | 32.65 | 0.6 |
| Reach 1 | 59035 | Comer Bridge | | | | | | | | | |
| Reach 1 | 59000 | 778.8 | 366.62 | 370.18 | 370.1 | 371.45 | 0.018716 | 9.04 | 86.18 | 31.77 | 0.97 |
| Reach 1 | 58911 | 778.8 | 366.29 | 369.27 | | 369.93 | 0.012349 | 6.51 | 119.71 | 59.79 | 0.81 |
| Reach 1 | 58822 | 778.8 | 365.08 | 368.18 | 368.03 | 368.65 | 0.015311 | 5.49 | 141.81 | 106.75 | 0.84 |
| Reach 1 | 58733 | 778.8 | 363.34 | 366.21 | 366.21 | 367.04 | 0.020783 | 7.31 | 106.57 | 64.33 | 1 |
| Reach 1 | 58708 | 778.8 | 353.05 | 354.07 | 355.56 | 364.55 | 0.767818 | 25.98 | 29.98 | 41.18 | 5.37 |
| Reach 1 | 58658 | 778.8 | 353.45 | 357.3 | 357 | 358.16 | 0.012788 | 7.45 | 104.57 | 43.24 | 0.84 |
| Reach 1 | 58608 | 778.8 | 352.81 | 356.5 | 356.41 | 357.43 | 0.016635 | 7.72 | 100.83 | 48.25 | 0.94 |
| Reach 1 | 58508 | 778.8 | 351.32 | 355.97 | | 356.41 | 0.005289 | 5.32 | 146.33 | 51.05 | 0.55 |
| Reach 1 | 58308 | 778.8 | 349.09 | 353.23 | 353.2 | 354.56 | 0.017532 | 9.26 | 84.13 | 30.58 | 0.98 |
| Reach 1 | 58108 | 778.8 | 346.97 | 351.84 | | 352.47 | 0.005866 | 6.34 | 122.75 | 33.97 | 0.59 |
| Reach 1 | 57975 | 778.8 | 345.1 | 351.33 | | 351.81 | 0.003682 | 5.57 | 139.9 | 30.12 | 0.46 |
| Reach 1 | 57804 | 778.8 | 343.8 | 350.93 | | 351.12 | 0.003422 | 3.44 | 226.59 | 45.71 | 0.27 |
| Reach 1 | 57619 | 778.8 | 342.5 | 350.43 | | 350.57 | 0.002402 | 3.05 | 255.65 | 46.93 | 0.23 |
| Reach 1 | 57558 | 778.8 | 341.78 | 350.1 | | 350.35 | 0.004381 | 3.98 | 195.77 | 36.04 | 0.3 |
| Reach 1 | 57509 | 778.8 | 341.9 | 350.01 | | 350.15 | 0.002206 | 3.02 | 257.6 | 43.68 | 0.22 |
| Reach 1 | 57388 | 778.8 | 340.6 | 349.2 | | 349.27 | 0.143314 | 2.2 | 354.37 | 71.43 | 0.17 |

# Appendix F.3
# HEC-RAS Evaluation of Wardell Road Flow Height
# for 11 February 1992

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Reach 1 | 57188 | 778.8 | 339.1 | 344.59 | | 344.93 | 0.008163 | 4.7 | 165.59 | 40.2 | 0.41 |
| Reach 1 | 57058 | 778.8 | 337.19 | 342.91 | | 343.47 | 0.014998 | 5.96 | 130.74 | 34.22 | 0.54 |
| Reach 1 | 56979 | 778.8 | 336.3 | 342.09 | | 342.48 | 0.009046 | 5.04 | 154.56 | 35.81 | 0.43 |
| Reach 1 | 56776 | 778.8 | 334.1 | 340.06 | | 340.51 | 0.010221 | 5.37 | 145.16 | 32.87 | 0.45 |
| **Reach 1** | **56731** | **778.8** | **334** | **338.76** | **337.87** | **340.05** | **0.002578** | **9.13** | **85.45** | **18.02** | **0.74** |
| **Reach 1** | **56730 Wardell Bridge** | | | | | | | | | | |
| **Reach 1** | **56706** | **778.8** | **333.3** | **337.17** | **337.17** | **339.11** | **0.005988** | **11.17** | **69.73** | **18** | **1** |
| Reach 1 | 56670 | 778.8 | 331.8 | 337.49 | 335.26 | 337.91 | 0.009527 | 5.19 | 150.08 | 34.13 | 0.44 |
| Reach 1 | 56625 | 778.8 | 330.4 | 337.21 | | 337.52 | 0.005831 | 4.5 | 173.22 | 30.88 | 0.33 |
| Reach 1 | 56596 | 778.8 | 328.97 | 336.92 | | 337.31 | 0.007316 | 5.04 | 154.49 | 25.56 | 0.36 |
| Reach 1 | 56574 | 778.8 | 329.8 | 336.66 | | 337.11 | 0.009246 | 5.38 | 144.67 | 28.16 | 0.42 |
| Reach 1 | 56474 | 778.8 | 329 | 335.66 | | 336.14 | 0.010163 | 5.56 | 140.16 | 28.11 | 0.44 |
| Reach 1 | 56275 | 778.8 | 327.3 | 333.82 | | 334.24 | 0.008688 | 5.19 | 150.18 | 29.58 | 0.41 |
| Reach 1 | 56200 | 778.8 | 326.4 | 333.65 | | 333.8 | 0.002327 | 3.09 | 251.92 | 42.19 | 0.22 |
| Reach 1 | 56100 | 778.8 | 326 | 333.25 | | 333.48 | 0.004031 | 3.82 | 207.12 | 54.09 | 0.29 |
| Reach 1 | 56074 | 778.8 | 325.18 | 332.71 | | 333.23 | 0.010946 | 5.75 | 135.34 | 25.72 | 0.44 |
| Reach 1 | 56058 | 778.8 | 325.18 | 332.45 | | 333.02 | 0.012533 | 6.05 | 128.75 | 25.19 | 0.47 |
| Reach 1 | 56000 | 778.8 | 325.7 | 331.94 | | 332.34 | 0.008634 | 5.08 | 154.93 | 43.41 | 0.41 |
| Reach 1 | 55902 | 778.8 | 323.9 | 331.29 | | 331.57 | 0.006158 | 4.46 | 192.49 | 69.54 | 0.34 |
| Reach 1 | 55872 | 778.8 | 323.8 | 330.84 | | 331.29 | 0.009553 | 5.39 | 144.52 | 29.96 | 0.43 |
| Reach 1 | 55800 | 778.8 | 323.4 | 330.14 | | 330.59 | 0.009975 | 5.35 | 145.51 | 30.55 | 0.43 |
| Reach 1 | 55706 | 778.8 | 322.4 | 329.28 | | 329.7 | 0.008763 | 5.18 | 150.43 | 31.03 | 0.41 |
| Reach 1 | 55606 | 778.8 | 320.3 | 328.62 | | 328.94 | 0.00583 | 4.52 | 172.24 | 30.78 | 0.34 |
| Reach 1 | 55558 | 778.8 | 321.08 | 327.43 | | 328.3 | 0.021287 | 7.46 | 104.38 | 20.26 | 0.58 |
| Reach 1 | 55505 | 778.8 | 319.6 | 327.33 | | 327.56 | 0.003949 | 3.85 | 203.45 | 46.14 | 0.28 |
| Reach 1 | 55405 | 778.8 | 319.1 | 326.42 | | 326.9 | 0.009641 | 5.55 | 140.45 | 24.96 | 0.41 |
| Reach 1 | 55306 | 778.8 | 318.3 | 325.69 | | 326.02 | 0.006968 | 4.67 | 171.71 | 53.64 | 0.37 |
| Reach 1 | 55206 | 778.8 | 318 | 325.04 | | 325.33 | 0.006414 | 4.32 | 185.55 | 78.17 | 0.36 |
| Reach 1 | 55108 | 778.8 | 316.46 | 323.75 | | 324.34 | 0.014575 | 6.15 | 127.3 | 39.16 | 0.51 |
| Reach 1 | 55005 | 778.8 | 316.1 | 323.1 | | 323.33 | 0.005099 | 4.1 | 222.53 | 111.94 | 0.32 |
| Reach 1 | 54905 | 778.8 | 315.7 | 322.31 | | 322.62 | 0.009722 | 4.53 | 179.51 | 98.27 | 0.42 |
| Reach 1 | 54805 | 778.8 | 314.7 | 321.57 | | 321.75 | 0.006734 | 3.49 | 237.4 | 116.07 | 0.35 |
| Reach 1 | 54705 | 778.8 | 314.5 | 321.14 | | 321.3 | 0.003142 | 3.25 | 254.64 | 118.96 | 0.26 |
| Reach 1 | 54596 | 778.8 | 313.25 | 320.23 | | 320.67 | 0.0096 | 5.31 | 147.16 | 34.57 | 0.43 |
| Reach 1 | 54511 | 778.8 | 312.7 | 320.15 | | 320.27 | 0.003304 | 2.78 | 307.42 | 169.85 | 0.26 |
| Reach 1 | 54496 | 778.8 | 312.53 | 319.77 | | 320.16 | 0.000332 | 5.04 | 179.28 | 105.45 | 0.39 |
| Reach 1 | 54440 | 778.8 | 311.9 | 319.76 | | 320.13 | 0.000447 | 5.42 | 335.11 | 255.98 | 0.37 |
| Reach 1 | 54431 | 778.8 | 311.9 | 318.63 | 316.72 | 319.86 | 0.001641 | 8.92 | 87.34 | 13.06 | 0.61 |
| Reach 1 | 54430 RR Bridge | | | | | | | | | | |
| Reach 1 | 54396 | 778.8 | 311.4 | 316.2 | 316.2 | 318.62 | 0.004103 | 12.49 | 62.37 | 13 | 1 |
| Reach 1 | 54305 | 778.8 | 309.9 | 311.94 | 313.3 | 316.61 | 0.351543 | 17.34 | 44.91 | 25.7 | 2.31 |
| Reach 1 | 54296 | 778.8 | 308.62 | 312.99 | 312.99 | 314.39 | 0.063132 | 9.47 | 82.21 | 29.98 | 1.01 |


3/11/92
Flow Height Markings

# Appendix G

## SEDIMENT ANALYSIS SUMMARY

## APPENDIX G: SEDIMENT ANALYSIS SUMMARY

The sediment transport analysis used for this feasibility study was developed as a screening level assessment for the purpose of comparing possible impacts from the two alternatives to existing conditions. This analysis was prepared in advance of a future design effort and is not considered to provide design-level information.

This appendix provides a summary of the approach used to develop the sediment transport analysis for the pre-planning study. The appendix includes the following:

- Summary of the approach.
- Table G.1 summarizing the estimation of sediment supply
- Tables G.2, G.3, G.4, and G.5, which provide summary results from the analysis for existing conditions and the three alternatives.
- Table G.6 summarizing the pre-dam construction slope for various portions of the study reach.
- Figures G.1, G.2, G.3, G.4, which provide a summary of the sensitivity analysis results described below.
- Selected pages from Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 20 (HEC-20) [Ref. 2], presenting the basis for the approach used in this study.
- Sample calculations.

### Summary of Approach

The sediment transport analysis approach was selected in consultation with the District to be an analytical approach rather than a numerical, computer based approach. A method that relies on a computer model, such as the U.S. Army Corps of Engineers HEC-6 model, requires an adequate input data set. In the absence of sieve analysis data for this project, a computer model offers no distinct advantage over simplified analytical methods.

The approach consists of a mass balance analysis, comparing the sediment supply entering a stream channel cross section with the sediment capacity for the given geometry and flow conditions at that cross section. If the supply is greater than the capacity, sediment deposition occurs. If the supply is less than the capacity, erosion occurs. The analysis was conducted for existing conditions in the study reach (which is defined in Section 4 of the pre-planning study report), as well as for each alternative.

### Input Data

Critical input parameters include the model flow rate, the estimated sediment supply, and the channel geometry (e.g., slope, width, depth). Sediment capacity at a channel cross-section is a function of the channel slope, the flow velocity, and the depth of flow. Input parameters were defined as follows:

Model Flow Rate: The sediment transport analysis is based on the results of the HEC-RAS model for the 2.5-year storm event. The District provided a value of 220 cfs for the 2.5-year peak flow volume.

Estimated Sediment Supply: Table G.1 consists of summary of the approach used to estimate the sediment supply for this study. The sediment supply was estimated from maintenance records provided by the District listing the volume of sediment removed from the Comer Debris Basin between 1978 and 1992. In addition, the USGS 1978 Interim Report [Ref. 1] included two additional data points identifying an estimated volume of sediment removed from the basin in 1974 and 1975.

The sediment supply value was used to analyze the potential for erosion or sedimentation at each cross section. The supply value was not reduced or increased at downstream cross sections to reflect erosion or sedimentation effects from upstream cross sections.

Channel Geometry: Channel geometry is based on the HEC-RAS cross sections, which are described in Appendix E. Variations between existing conditions and the alternatives are reflected in the changes to channel geometry that define each of the alternatives.

## Use of FHWA HEC-20

The sediment analysis was performed using the analytical approach identified in FHWA HEC-20 [Ref. 2]. HEC-20 offers the following:

- Simplified means of performing a basic mass balance comparison of sediment supply to sediment capacity

- Convenient analytical tool for estimating elevation changes due to sediment erosion or buildup.

### Applicability of HEC-20

The HEC-20 approach is based on a regression equation methodology that is applicable to a specific range of conditions for flow velocity, channel slope, and sediment distribution, as indicated in HEC-20 Table 6.1 [Ref 2]. Generally, HEC-20 is best suited for lower flow velocities (i.e., below 8 fps and Froude Numbers < 0.7), gradual channel slopes (i.e., less than 0.002 ft/ft) and fine-grained sediment distributions (i.e., $D_{50} = 2.0$mm). These conditions do not always hold for the Calabazas Creek study reach.

In cases where the conditions do not conform to the applicable range of the HEC-20 approach, the analysis produces predictions of large-magnitude erosion, particularly immediately downstream of bridges. These predictions are associated with high Froude Numbers and are considered outliers that have been disregarded. Since this analysis has been conducted at a screening level, the general trends in the results have been used to draw conclusions, rather than results at specific cross sections.

## Summary Description of Analysis

The analysis was conducted using the following general steps:

- Develop the HEC-RAS model results for the 2.3-year storm event for existing conditions (Alt. 1), and Alternatives 2, 3, and 4. Survey data from 1978, 1987, and 2001 was used to generate the cross sections defining stream channel geometries.

- Estimate the sediment supply. This step is summarized in Table G.1. The sediment supply estimate is based on the assumption that the majority of the sediment moving in the upper portions of Calabazas Creek occurs during 3 or 4 major storm events in the water year. This assumption is based on a conclusion made by the USGS [Ref. 1]. The amount of time associated with the sediment supply is also based on the assumption of a few storms causing the majority of sediment movement. Sediment supply volume and the supply time are the variables used in a sensitivity analysis summarized below.

- The following steps were performed using the approach defined in HEC-20:

1. Assess the maximum particle size subject to incipient motion at each cross section for the given flow volume.

2. Evaluate the potential for "armoring" of the channel bed. The evaluation results in an estimate of the depth of scour required to reach an armor layer at each cross section. The armoring evaluation was conducted for the reach between Comer Drive and the Wardell Road bridges, as shown in Tables G.2 through G.5.

   An alternative approach from the Bureau of Reclamation (BuRec) was used to evaluate the depth to the armor layer for the same reach, based on average channel slope results [Ref. 4]. The alternative analysis produced a value of 10 inches. The results of the BuRec approach are provided in this appendix with the sample calculations.

3. Compute an equilibrium slope for two conditions: no sediment supply, and the estimated sediment supply. The equilibrium slope identifies a condition in which sediment capacity equals the sediment supply, and there is no net erosion or sedimentation.

   An assumption of no sediment supply implies a condition of an equilibrium slope where no sediment transport occurs. This is usually a shallower slope than a condition in which there is a sediment supply, and a "no sediment" equilibrium slope calculation is intended to provide a lower bound to the estimate of an equilibrium slope. The results are presented in Tables G.2 through G.5. The HEC-20 methodology is based on the sediment distribution curve, which has been approximated for this project using an example curve provided in Figure E.1 in Appendix E of the HEC-20 reference [Ref 2].

   Computation of an equilibrium slope for the estimated sediment supply is also summarized for each section on Tables G.2 through G.5. The results rely on the regression equation approach defined in HEC-20, Chapter 6 (Equation 6.24). An evaluation of pre-dam construction profile channel slopes, which are summarized in Table G.5, identifies the slope between Pierce Road and Comer Drive bridges to be approximately 1.3%, and between the Comer Drive and Wardell Road bridges to be approximately 1.4%.

   The regression equation for existing conditions predicted an equilibrium slope of 1.5% between Pierce and Comer. However, the regression equation was not as accurate for the reach between Comer and Wardell because it predicts an equilibrium slope of 5.1%. An alternative approach was used to estimate the equilibrium slope between Comer and Wardell using the estimated sediment supply. BuRec provides a means of assessing an equilibrium slope using a method based on the Meyer-Peter/Muller equation [Ref 4]. A slope of 1.4% was estimated for the reach between Comer and Wardell using the BuRec approach, and this corresponds to pre-dam construction conditions. This result, along with the regression equation result for the Pierce to Comer reach, reinforces the assumption that pre-dam construction conditions were at equilibrium. The pre-dam construction slope was used for HEC-RAS modeling of alternatives as a means of approximating an equilibrium channel slope in the model.

4. Estimate the elevation change at each cross section to assess the potential for sedimentation and erosion. This step involves comparing the sediment transport capacity of the steam at each cross section with the estimated sediment supply. Erosion is predicted when the capacity exceeds the supply, and sedimentation is predicted when the supply exceeds the capacity. Based on field observations, the expected range of either erosion or sedimentation is 0 to 2 feet. Results that fall outside of this range are considered artifacts of model limitations.

## Sensitivity Analysis

A sensitivity analysis was performed to observe the impacts of variations in sediment supply volume and sediment supply duration on the estimates of equilibrium slope (computed using the HEC-20 regression equation) and the change in channel bed elevation (i.e., erosion or sedimentation).

The results of this analysis are provided in Figures G.1 through G.4. The analysis was conducted using average values of equilibrium slope and elevation change for three main parts of the study reach: Upstream to Comer Drive bridge, Comer Drive bridge to Wardell Road bridge, and Wardell Road bridge to the Union Pacific Railroad bridge.

The results lead to the following observations:

1. An increasing sediment supply results in a trend toward a prediction of more sedimentation, particularly between Comer Drive and the railroad. These results appear on Figure G.1.

2. An increasing sediment supply will result in an increase in the equilibrium slope predicted using the HEC-20 regression equation. The equilibrium slope estimated for Comer to Wardell will increase at the greatest rate with an increasing sediment supply. The results shown on Figure G.2 suggest that equilibrium slopes that can be considered likely occur for sediment supplies between 5,000 and 10,000 tons/year.

3. Increasing values for sediment supply duration produce a trend toward less sedimentation and more erosion, as shown on Figure G.3. The rate of the trend toward erosive conditions with increasing time is highest for the portion of the study reach between Wardell and the railroad. For durations greater than approximately 40 days, the elevation change results tend to be negative (i.e. erosive) for all three portions of the study reach.

4. As shown on Figure G.4, an increase in the assumed duration of sediment supply results in a significant reduction in the predicted equilibrium slope.

The sediment transport analysis was conducted using an estimated sediment supply duration of 35 days, which was selected because it resulted in an equilibrium slope value of 1.5% for the portion of the study reach between Pierce and Comer. As noted above, this result correlates well with pre-dam construction data.

The 35-day duration was selected because it appeared to produce the most acceptable balance between:

- The need to limit the trend of increasing predicted erosion with increasing supply duration, and
- The need to estimate an equilibrium slope between 1.0% and 2.0%.

# Table G.1
# Estimate of Sediment Supply
# Comer Debris Basin Engineering Feasibility Study

**Average Loading Rate**

| Year | Time Between Excavations | | Length of Excavation | Excavation Volume | Volume | unit weight[1], γ | Weight | Loading Rate | Source |
|---|---|---|---|---|---|---|---|---|---|
| | days | years | total ft | total yd$^3$ | ft$^3$ | lb/ft$^3$ | lb | ton/year | |
| **1974** | 365 | 1 | NA | **2276.0** | 61452.0 | 110 | 6759720.0 | 3379.86 | 1975 USGS Report[1] |
| **1975** | 365 | 1 | NA | **3256.0** | 87912.0 | 110 | 9670320.0 | 4835.16 | 1975 USGS Report[1] |
| **1978** | 1095 | 3 | 1050 | **4864.0** | 131328.0 | 110 | 14446080.0 | 2407.68 | SCVWD Maint Records |
| **1982** | 1466 | 4.02 | 500 | **6750.0** | 182250.0 | 110 | 20047500.0 | 2495.68 | SCVWD Maint Records |
| **1983** | 533 | 1.46 | 500 | **12000.0** | 324000.0 | 110 | 35640000.0 | 12203.19 | SCVWD Maint Records |
| **1985** | 781 | 2.14 | 650 | **3140.0** | 84780.0 | 110 | 9325800.0 | 2179.20 | SCVWD Maint Records |
| **1986** | 362 | 0.99 | 650 | **9080.0** | 245160.0 | 110 | 26967600.0 | 13595.54 | SCVWD Maint Records |
| **1990** | 1510 | 4.14 | 500 | **7500.0** | 202500.0 | 110 | 22275000.0 | 2692.18 | SCVWD Maint Records |
| **1991** | 313 | 0.86 | 400 | **3730.0** | 100710.0 | 110 | 11078100.0 | 6459.28 | SCVWD Maint Records |
| **1992** | 297 | 0.81 | 850 | **7500.0** | 202500.0 | 110 | 22275000.0 | 13687.50 | SCVWD Maint Records |
| | | | | | | | Σ | 55720.25 | |

Average Loading Rate = Sediment Supply (ton/yr) = 5600.0

**Sediment Distribution[2]**

| Year | Annual Discharge (tonnes) | | Annual Discharge (tons) | | Total | Percent Total (%) | |
|---|---|---|---|---|---|---|---|
| | silt / clay | sand / gravel | silt / clay | sand / gravel | | silt / clay | sand / gravel |
| 1973 | 833 | 533 | 916.3 | 586.3 | 1502.6 | 61.0% | 39.0% |
| 1974 | 324 | 200 | 356.4 | 220 | 576.4 | 61.8% | 38.2% |
| 1975 | 425 | 310 | 467.5 | 341 | 808.5 | 57.8% | 42.2% |
| | | | | | Σ | 180.6% | 119.4% |
| | | | | | Average Percent Total = | 60.2% | 39.8% |

**Adjustment to Sediment Supply**

Assume Comer Basin traps only sand and gravel fraction = 40% of total. Total sediment load = Basin Load x 1.6.

| Avg. Load | Factor | Sed Supply (ton/yr) |
|---|---|---|
| 5600 | 1.6 | **8960** |

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Notes:

1) Density value taken from Interim Report on Streamflow, Sediment Discharge, and Water Quality in the Calabazas Creek Basin, Santa Clara County, California, USGS, 1975. Table 5.

2) Ibid, Table 2, Station 11169580: Calabazas Creek Tributary at Mt. Eden Road, near Saratoga.

# Table G.2
# Existing Conditions
# Sediment Analysis Summary

**Input Values**

| **Factors** | |
|---|---|
| Ks | 0.03 |
| Ku | 1.486 |
| K(mpm) | 60.1 |
| Unit Weight H20 (pcf) | 62.4 |
| Unit Weight SED (pcf) | 165 |
| D90 (mm) | 250 |
| D90 (ft) | 0.820 |
| D50 (mm) | 110.0 |
| D50 (ft) | 0.361 |

| Exponents | |
|---|---|
| a | 3.036E-06 |
| b | 3.419 |
| c | 0.867 |

**Upstream Sediment Supply**

Based on estimate of sed supply from USGS 1975 Report

| | |
|---|---|
| Est. total | 9000 tons |
| Sed Loading Period | 35 days |
| Time Δt | 3024000 sec |
| Sed Volume | 1.09E+05 cu. ft. |
| $Q_s$ | 0.036 cfs |
| Prospect Rd Sta | 52041 |

Assume Majority of Sed Load from 3 or 4 Major Storms in Water Year

Assume Sediment Porosity 0.4

**2.3 YR RAS Input Data**

| River Sta | Mann Wtd Chnl | Q Channel (cfs) | 2.3 Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3Yr Max Chl Dpth (ft) | Incipient Motion (ft) | Corner to Wardell Depth to Armor (ft) | Eq Slope Shields (No Sed Supply) (ft/ft) | Eq Slope (MP-M) (No Sed Supply) (ft/ft) | Eq Slope (Regression) (Sed Supply) (ft/ft) | Transport Capacity $qs = aV^bY^c$ ($ft^2/s$) | Sediment Outflow qsWΔt ($ft^3$) | Net Change ΔV= Supply - Outflow ($ft^3$) | Distance to Prospect Rd. (ft) | Alt. 1 Base El. Change ΔZ (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69696 | 0.04 | 220 | 9.39 | 3.09 | 1.01 | 9.15 | 3.59 | 1.00 | | 0.015 | 0.016 | 0.003 | 1.78E-02 | 5.06E+05 | -3.97E+05 | 17655 | (3.99) |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.16 | 8.12 | 2.19 | 0.85 | | 0.026 | 0.028 | 0.007 | 7.72E-03 | 4.13E+05 | -3.04E+05 | 17455 | (1.64) |
| 69196 | 0.04 | 220 | 30.67 | 1.18 | 0.82 | 5.34 | 2.01 | 0.38 | | 0.042 | 0.045 | 0.014 | 1.71E-03 | 1.60E+05 | -5.05E+04 | 17155 | (0.16) |
| 68696 | 0.04 | 220 | 28.68 | 1.51 | 0.94 | 6 | 1.54 | 0.49 | | 0.040 | 0.042 | 0.012 | 2.02E-03 | 1.75E+05 | -6.62E+04 | 16655 | (0.23) |
| 68396 | 0.04 | 220 | 21.84 | 1.91 | 1 | 6.86 | 3.18 | 0.62 | | 0.031 | 0.033 | 0.009 | 6.05E-03 | 4.00E+05 | -2.91E+05 | 16355 | (1.36) |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.39 | 10.05 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.005 | 1.64E-02 | 6.68E+05 | -5.59E+05 | 15755 | (4.39) |
| 67396 | 0.04 | 220 | 27.93 | 1.28 | 0.83 | 5.61 | 2.08 | 0.42 | | 0.039 | 0.041 | 0.012 | 2.08E-03 | 1.76E+05 | -6.70E+04 | 15355 | (0.26) |
| 66996 | 0.04 | 220 | 29.36 | 1.69 | 1.01 | 6.28 | 2.14 | 0.55 | | 0.040 | 0.043 | 0.013 | 3.14E-03 | 2.79E+05 | -1.70E+05 | 14955 | (0.64) |
| 66865 | 0.04 | 220 | 17.87 | 0.83 | 0.53 | 4.83 | 2.75 | 0.27 | | 0.026 | 0.028 | 0.007 | 1.59E-03 | 8.60E+04 | 2.31E+04 | 14824 | 0.15 |
| 66850 | 0.04 | 220 | 24.97 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.011 | 8.14E-04 | 6.15E+04 | 4.76E+04 | 14809 | 0.21 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.010 | 2.98E-03 | 2.14E+05 | -1.05E+05 | 14755 | (0.50) |
| 66396 | 0.04 | 220 | 21.6 | 2.08 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.009 | 5.10E-03 | 3.33E+05 | -2.24E+05 | 14355 | (1.20) |
| 66246 | 0.04 | 220 | 25.52 | 0.87 | 0.63 | 4.8 | 3.59 | 0.28 | | 0.036 | 0.038 | 0.011 | 1.96E-03 | 1.51E+05 | -4.24E+04 | 14205 | (0.19) |
| 66245 | Vista Regina Bridge | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.98 | 1.01 | 6.98 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.009 | 5.71E-03 | 3.65E+05 | -2.56E+05 | 14175 | (1.42) |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.61 | 1.09 | | 0.038 | 0.040 | 0.012 | 7.65E-03 | 6.33E+05 | -5.24E+05 | 14055 | (2.27) |
| 65796 | 0.04 | 220 | 26.44 | 1.75 | 1 | 6.46 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.011 | 2.70E-03 | 2.16E+05 | -1.07E+05 | 13755 | (0.49) |
| 65196 | 0.04 | 220 | 34.85 | 0.86 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.016 | 9.04E-04 | 9.52E+04 | 1.39E+04 | 13155 | 0.05 |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.98 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.004 | 1.65E-02 | 4.92E+05 | -3.83E+05 | 12555 | (5.15) |
| 63996 | 0.04 | 220 | 17.45 | 1.85 | 0.91 | 6.97 | 2.69 | 0.60 | | 0.026 | 0.027 | 0.007 | 5.47E-03 | 2.89E+05 | -1.80E+05 | 11955 | (1.44) |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.026 | 0.028 | 0.007 | 6.89E-03 | 3.68E+05 | -2.59E+05 | 11655 | (2.10) |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.87 | 0.19 | | 0.032 | 0.034 | 0.009 | 9.67E-04 | 6.61E+04 | 4.29E+04 | 11579 | 0.27 |
| 63596 | 0.04 | 220 | 28.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.013 | 3.93E-04 | 3.44E+04 | 7.47E+04 | 11555 | 0.37 |
| 63396 | 0.04 | 220 | 12.45 | 2.59 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.005 | 1.06E-02 | 3.99E+05 | -2.90E+05 | 11355 | (3.42) |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.05 | 2.48 | 0.85 | | 0.026 | 0.028 | 0.007 | 8.35E-03 | 4.45E+05 | -3.36E+05 | 10755 | (2.95) |
| 62690 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.008 | 2.74E-03 | 1.62E+05 | -5.32E+04 | 10649 | (0.43) |
| 62689 | Pierce Bridge | | | | | | | | Pierce Bridge | | | | | | | | |
| 62662 | 0.04 | 220 | 19.95 | 2.1 | 1.01 | 7.10 | 2 | 0.68 | | 0.029 | 0.031 | 0.008 | 4.57E-03 | 2.76E+05 | -1.67E+05 | 10621 | (1.31) |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.83 | 10.37 | 2.02 | 1.59 | | 0.031 | 0.032 | 0.009 | 1.66E-02 | 1.07E+06 | -9.60E+05 | 10590 | (7.10) |
| 62596 | 0.04 | 220 | 26.38 | 1.99 | 1.09 | 6.82 | 2.05 | 0.65 | | 0.037 | 0.039 | 0.011 | 4.01E-03 | 3.20E+05 | -2.11E+05 | 10555 | (1.26) |
| 62096 | 0.04 | 220 | 47.48 | 0.76 | 0.7 | 4.17 | 1.98 | 0.25 | | 0.061 | 0.064 | 0.022 | 7.24E-04 | 1.04E+05 | 5.09E+03 | 10055 | 0.02 |
| 61696 | 0.04 | 220 | 25.73 | 1.45 | 0.88 | 5.97 | 2.3 | 0.47 | | 0.036 | 0.038 | 0.011 | 2.81E-03 | 2.19E+05 | -1.10E+05 | 9655 | (0.74) |
| 61396 | 0.04 | 220 | 21.9 | 1.06 | 0.69 | 5.34 | 2.67 | 0.34 | | 0.031 | 0.033 | 0.009 | 2.19E-03 | 1.45E+05 | -3.57E+04 | 9355 | (0.29) |
| 60696 | 0.04 | 220 | 21.85 | 1.91 | 1 | 6.87 | 2.95 | 0.62 | | 0.031 | 0.033 | 0.009 | 5.64E-03 | 3.73E+05 | -2.64E+05 | 8855 | (2.27) |
| 60396 | 0.04 | 220 | 39.21 | 0.26 | 0.33 | 2.69 | 3.03 | 0.08 | | 0.052 | 0.055 | 0.018 | 2.34E-04 | 2.77E+04 | 8.13E+04 | 8355 | 0.41 |
| 59796 | 0.04 | 220 | 39.94 | 1.29 | 0.93 | 5.35 | 2.08 | 0.42 | | 0.053 | 0.056 | 0.018 | 1.77E-03 | 2.14E+05 | -1.05E+05 | 7755 | (0.56) |
| 59500 | 0.04 | 220 | 25.34 | 1.79 | 1 | 6.56 | 1.73 | 0.58 | | 0.036 | 0.038 | 0.011 | 3.03E-03 | 2.32E+05 | -1.23E+05 | 7459 | (1.09) |
| 59396 | 0.04 | 220 | 69.54 | 0.05 | 0.14 | 1.26 | 3.89 | 0.02 | | 0.085 | 0.089 | 0.035 | 2.17E-05 | 4.57E+03 | 1.05E+05 | 7355 | 0.34 |
| 59300 | 0.04 | 220 | 43.32 | 0.44 | 0.47 | 3.32 | 2.57 | 0.14 | | 0.056 | 0.060 | 0.020 | 4.17E-04 | 5.46E+04 | 5.45E+04 | 7259 | 0.29 |
| 59100 | 0.04 | 220 | 38.11 | 1.53 | 1.02 | 5.78 | 2.06 | 0.50 | | 0.050 | 0.053 | 0.017 | 2.29E-03 | 2.64E+05 | -1.55E+05 | 7059 | (0.96) |
| 59096 | 0.04 | 220 | 39.98 | 0.24 | 0.31 | 2.59 | 2.83 | 0.08 | | 0.053 | 0.056 | 0.018 | 1.94E-04 | 2.34E+04 | 8.57E+04 | 7055 | 0.51 |
| 59036 | 0.04 | 220 | 31.84 | 0.53 | 0.48 | 3.74 | 2.82 | 0.17 | | 0.043 | 0.046 | 0.014 | 6.78E-04 | 6.53E+04 | 4.38E+04 | 6995 | 0.33 |
| Average | | | 34.12 | 1.35 | 0.79 | 5.20 | 2.47 | | | 0.046 | 0.048 | 0.015 | | | | | (0.91) |
| 59035 | Corner Bridge | | | | | | | | Corner Bridge | | | | | | | | |
| 59000 | 0.04 | 220 | 31.11 | 0.9 | 0.68 | 4.7 | 2.31 | 0.29 | 0.58 | 0.042 | 0.045 | 0.014 | 1.25E-03 | 1.17E+05 | -8.17E+03 | 6959 | (0.06) |
| 58911 | 0.04 | 220 | 50.25 | 0.63 | 0.62 | 3.8 | 1.87 | 0.20 | 0.41 | 0.064 | 0.068 | 0.024 | 5.02E-04 | 7.62E+04 | 3.29E+04 | 6870 | 0.16 |
| 58822 | 0.04 | 220 | 62.1 | 0.81 | 0.78 | 4.11 | 2.03 | 0.26 | 0.53 | 0.077 | 0.081 | 0.031 | 7.04E-04 | 1.32E+05 | -2.32E+04 | 6781 | (0.09) |
| 58733 | 0.04 | 220 | 62.98 | 1.17 | 1 | 4.81 | 1.91 | 0.38 | 0.76 | 0.078 | 0.082 | 0.031 | 1.14E-03 | 2.18E+05 | -1.09E+05 | 6692 | (0.43) |
| 58706 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | | 0.054 | 0.057 | 0.019 | 7.79E-05 | 9.75E+03 | 9.93E+04 | 6667 | 0.60 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.36 | 2.09 | 0.37 | 0.75 | 0.039 | 0.041 | 0.012 | 1.79E-03 | 1.51E+05 | -4.19E+04 | 6617 | (0.38) |
| 58608 | 0.04 | 220 | 29.17 | 1.08 | 0.76 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.013 | 1.62E-03 | 1.43E+05 | -3.38E+04 | 6567 | (0.29) |
| 58508 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.59 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 1.23E-03 | 1.39E+05 | -3.02E+04 | 6467 | (0.21) |
| 58308 | 0.04 | 220 | 23.86 | 0.96 | 0.66 | 5.06 | 2.65 | 0.31 | 0.62 | 0.034 | 0.036 | 0.010 | 1.81E-03 | 1.30E+05 | -2.12E+04 | 6267 | (0.24) |
| 58108 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.81 | 0.58 | 2.63 | 0.035 | 0.037 | 0.011 | 3.22E-03 | 2.42E+05 | -1.33E+05 | 6067 | (1.47) |
| 57975 | 0.04 | 220 | 21.89 | 0.58 | 0.46 | 4.08 | 2.77 | 0.19 | 0.38 | 0.031 | 0.033 | 0.009 | 8.99E-04 | 5.95E+04 | 4.96E+04 | 5934 | 0.64 |
| 57804 | 0.07 | 220 | 31.33 | 0.67 | 0.28 | 2.58 | 3.46 | 0.22 | 0.44 | 0.026 | 0.093 | 0.042 | 2.28E-04 | 2.16E+04 | 8.75E+04 | 5763 | 0.81 |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.17 | 0.028 | 0.098 | 0.046 | 1.22E-04 | 1.23E+04 | 9.68E+04 | 5576 | 0.87 |
| 57558 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.57 | 4.76 | 0.20 | 0.33 | 0.022 | 0.077 | 0.033 | 2.96E-04 | 2.27E+04 | 8.63E+04 | 5517 | 1.03 |
| 57509 | 0.07 | 220 | 33.37 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | 0.10 | 0.028 | 0.098 | 0.046 | 8.77E-05 | 8.85E+03 | 1.00E+05 | 5468 | 0.92 |
| 57388 | 0.7 | 220 | 35.55 | 15.59 | 0.11 | 1.34 | 5.34 | 5.06 | | 0.004 | 1.994 | 4.907 | 3.53E-05 | 3.79E+03 | 1.05E+05 | 5347 | 0.92 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 1.00 | 0.026 | 0.091 | 0.041 | 4.53E-04 | 4.20E+04 | 6.71E+04 | 5147 | 0.71 |
| 57058 | 0.07 | 220 | 21.69 | 1.98 | 0.49 | 4.3 | 2.86 | 0.64 | 2.89 | 0.019 | 0.068 | 0.028 | 1.11E-03 | 7.26E+04 | 3.65E+04 | 5017 | 0.56 |
| 56979 | 0.07 | 220 | 26.79 | 1.21 | 0.38 | 3.4 | 2.92 | 0.39 | 4.72 | 0.023 | 0.081 | 0.035 | 5.05E-04 | 4.09E+04 | 6.82E+04 | 4938 | 0.86 |
| 56776 | 0.07 | 220 | 23.05 | 2.2 | 0.54 | 4.47 | 2.53 | 0.71 | 3.22 | 0.020 | 0.071 | 0.030 | 1.14E-03 | 7.92E+04 | 2.99E+04 | 4735 | 0.46 |
| 56731 | 0.02 | 220 | 17.93 | 0.33 | 0.74 | 6.01 | 2.04 | 0.11 | 0.11 | 0.048 | 0.011 | 0.002 | 2.59E-03 | 1.41E+05 | -3.16E+04 | 4690 | (0.63) |
| Average | | | 59.78 | 2.20 | 1.08 | 8.26 | 5.41 | | 3.03 | 0.070 | 0.127 | 0.051 | | | | | 0.51 |
| 56730 | Waudell Bridge | | | | | | | | Wardell Bridge | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.55 | 1 | 7.36 | 1.67 | 0.18 | | 0.048 | 0.011 | 0.002 | 4.36E-03 | 2.37E+05 | -1.27E+05 | 4665 | (2.54) |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.99 | 5.84 | | 0.019 | 0.067 | 0.027 | 1.16E-02 | 7.47E+05 | -6.38E+05 | 4629 | (10.80) |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.30 | | 0.022 | 0.077 | 0.033 | 3.66E-04 | 2.79E+04 | 8.12E+04 | 4584 | 1.17 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.27 | | 0.019 | 0.065 | 0.026 | 4.48E-04 | 2.82E+04 | 8.09E+04 | 4555 | 1.42 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.38 | 3.62 | 3.46 | 0.43 | | 0.019 | 0.066 | 0.027 | 7.25E-04 | 4.63E+04 | 6.28E+04 | 4533 | 1.09 |
| 56474 | 0.07 | 220 | 21.19 | 1.39 | 0.39 | 3.68 | 3.39 | 0.45 | | 0.019 | 0.066 | 0.027 | 7.53E-04 | 4.82E+04 | 6.08E+04 | 4433 | 1.08 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.06 | 2.88 | 0.58 | | 0.020 | 0.072 | 0.030 | 9.15E-04 | 6.41E+04 | 4.50E+04 | 4234 | 0.77 |
| 56200 | 0.07 | 220 | 34.8 | 0.39 | 0.2 | 2.01 | 3.55 | 0.13 | | 0.029 | 0.101 | 0.048 | 9.91E-05 | 1.04E+04 | 9.87E+04 | 4159 | 1.14 |
| 56100 | 0.07 | 220 | 27.95 | 0.67 | 0.26 | 2.6 | 3.61 | 0.22 | | 0.024 | 0.084 | 0.037 | 2.42E-04 | 2.05E+04 | 8.86E+04 | 4059 | 1.30 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.44 | | 0.017 | 0.060 | 0.023 | 8.74E-04 | 4.96E+04 | 5.95E+04 | 4033 | 1.31 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.86 | 3.98 | 0.49 | | 0.017 | 0.059 | 0.023 | 1.02E-03 | 5.67E+04 | 5.24E+04 | 4017 | 1.18 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.89 | 0.49 | | 0.021 | 0.074 | 0.031 | 7.12E-04 | 5.16E+04 | 5.75E+04 | 3959 | 1.01 |
| 55902 | 0.07 | 220 | 20.8 | 1.2 | 0.35 | 3.47 | 3.85 | 0.39 | | 0.019 | 0.065 | 0.026 | 6.88E-04 | 4.33E+04 | 6.58E+04 | 3861 | 1.37 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.48 | | 0.019 | 0.066 | 0.027 | 8.90E-04 | 5.70E+04 | 5.21E+04 | 3831 | 1.07 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.53 | | 0.019 | 0.067 | 0.027 | 9.21E-04 | 5.95E+04 | 4.95E+04 | 3759 | 1.03 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.65 | | 0.019 | 0.065 | 0.026 | 1.21E-03 | 7.57E+04 | 3.34E+04 | 3665 | 0.73 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.30 | | 0.019 | 0.067 | 0.027 | 5.08E-04 | 3.29E+04 | 7.62E+04 | 3565 | 1.66 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 1.22 | | 0.015 | 0.051 | 0.019 | 2.94E-03 | 1.40E+05 | -3.04E+04 | 3517 | (0.92) |
| 55505 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.20 | | 0.023 | 0.081 | 0.035 | 2.28E-04 | 1.84E+04 | 9.07E+04 | 3464 | 1.64 |
| 55405 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.40 | | 0.018 | 0.062 | 0.024 | 7.10E-04 | 4.17E+04 | 6.74E+04 | 3364 | 1.72 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.32 | | 0.020 | 0.072 | 0.030 | 5.05E-04 | 3.55E+04 | 7.36E+04 | 3265 | 1.62 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 0.40 | | 0.023 | 0.080 | 0.035 | 6.01E-04 | 4.81E+04 | 6.10E+04 | 3165 | 1.21 |
| 55108 | 0.07 | 220 | 17.94 | 1.78 | 0.43 | 4.16 | 4.02 | 0.58 | | 0.016 | 0.057 | 0.022 | 1.33E-03 | 7.20E+04 | 3.71E+04 | 3067 | 1.12 |
| 55005 | 0.07 | 220 | 23.25 | 1.18 | 0.36 | 3.4 | 3.48 | 0.38 | | 0.020 | 0.072 | 0.030 | 5.88E-04 | 4.13E+04 | 6.78E+04 | 2964 | 1.64 |
| 54905 | 0.07 | 220 | 22.93 | 1.34 | 0.39 | 3.6 | 3.03 | 0.44 | | 0.020 | 0.071 | 0.030 | 6.34E-04 | 4.39E+04 | 6.52E+04 | 2864 | 1.65 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.96 | 3.38 | 0.29 | | 0.022 | 0.076 | 0.033 | 3.57E-04 | 2.69E+04 | 8.22E+04 | 2764 | 1.99 |
| 54705 | 0.07 | 220 | 34.9 | 0.66 | 0.28 | 2.53 | 3.11 | 0.21 | | 0.029 | 0.102 | 0.048 | 1.94E-04 | 2.05E+04 | 8.86E+04 | 2664 | 1.59 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.75 | | 0.018 | 0.064 | 0.025 | 1.55E-03 | 9.46E+04 | 1.44E+04 | 2555 | 0.47 |
| 54511 | 0.07 | 220 | 24.21 | 2.76 | 0.63 | 4.9 | 2.78 | 0.90 | | 0.021 | 0.074 | 0.031 | 1.69E-03 | 1.24E+05 | -1.45E+04 | 2470 | (0.40) |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.45 | 2.21 | 0.10 | | 0.060 | 0.008 | 0.001 | 5.80E-03 | 3.05E+05 | -1.95E+05 | 2455 | (7.64) |
| 54440 | 0.015 | 220 | 13.78 | 0.23 | 0.77 | 6.74 | 2.56 | 0.07 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 1.95E+05 | -8.57E+04 | 2399 | (4.32) |
| 54431 | 0.015 | 220 | 12.96 | 0.23 | 0.74 | 6.7 | 2.54 | 0.07 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 1.78E+05 | -6.92E+04 | 2390 | (3.72) |
| Average | | | 22.00 | 1.78 | 0.50 | 4.24 | 3.26 | | | 0.024 | 0.063 | 0.026 | | | | | 0.05 |
| 54430 | RR Bridge | | | | | | | | RR Bridge | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 8.23 | 2.08 | 0.12 | | 0.046 | 0.006 | 0.001 | 7.73E-03 | 3.01E+05 | -1.92E+05 | 2355 | (10.54) |
| 54305 | 0.07 | 220 | 22.04 | 20.68 | 2.26 | 11.8 | 0.94 | 6.72 | | 0.020 | 0.069 | 0.028 | 1.33E-02 | 8.87E+05 | -7.78E+05 | 2264 | (25.99) |
| 54296 | 0.07 | 220 | 24.45 | 5.68 | 1 | 6.62 | 2.57 | 1.85 | | 0.021 | 0.075 | 0.032 | 4.41E-03 | 3.26E+05 | -2.17E+05 | 2255 | (6.56) |

# Table G.3
## Alternative 2
## Sediment Analysis Summary

**Input Values**

| **Factors** | | **Upstream Sediment Supply** | | | **Assume Sediment** | |
|---|---|---|---|---|---|---|
| Ks | 0.03 | Based on estimate of sed supply from USGS 1975 Report | | | Porosity | 0.4 |
| Ku | 1.486 | | | | | |
| K(mpm) | 60.1 | Est. total | 9000 | tons | | |
| Unit Weigt | 62.4 | Sed Loading Period | 35 | days | Assume Sed Load from 3 or 4 Major Storms in Water Year | |
| Unit Weigt | 165 | Time Δt | 3024000 | sec | | |
| D90 (mm) | 250 | | | | | |
| D90 (ft) | 0.820 | Sed Volume | 1.09E+05 | cu ft. | | |
| D50 (mm) | 110.0 | | | | | |
| D50 (ft) | 0.361 | $Q_s$ | 0.036 | cfs | | |
| Exponents | | Prospect Rd Sta | 52041 | | | |
| a | 3.036E-06 | | | | | |
| b | 3.419 | | | | | |
| c | 0.867 | | | | | |

| **RAS Input Data** River Sta | ann Wtd Cl | Q Channel (cfs) | 2.3Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3Yr Max Chl Dpth (ft) | **Incipient Motion (ft)** | **Corner to Wardell Depth to Armor (ft)** | **Eq Slope Shields (No Sed Supply) (ft/ft)** | **Eq Slope (MP-M) (No Sed Supply) (ft/ft)** | **Eq Slope (Regression) (Sed Supply) (ft/ft)** | **Transport Capacity $q_s = aV^bY^c$ $(ft^2/s)$** | **Sediment Outflow qsWΔt $(ft^3)$** | **Net Change ΔV= Supply - Outflow $(ft^3)$** | **Distance to Prospect Rd. (ft)** | **Alt. 2 Base El. Change ΔZ (ft)** | **ExCond Base El. Change DZ (ft)** | **Alt 1 ΔZ - ExCond ΔZ Delta (ft)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69696 | 0.04 | 220 | 9.39 | 3.09 | 1.01 | 9.15 | 3.59 | 1.00 | | 0.015 | 0.016 | 0.003 | 1.78E-02 | 5.06E+05 | -3.97E+05 | 17655 | (3.99) | (3.99) | 0.00 |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.16 | 8.12 | 2.19 | 0.85 | | 0.026 | 0.028 | 0.007 | 7.72E-03 | 4.13E+05 | -3.04E+05 | 17455 | (1.64) | (1.64) | 0.00 |
| 69196 | 0.04 | 220 | 30.87 | 1.18 | 0.82 | 5.34 | 2.01 | 0.38 | | 0.042 | 0.045 | 0.014 | 1.71E-03 | 1.60E+05 | -5.05E+04 | 17155 | (0.16) | (0.16) | 0.00 |
| 68696 | 0.04 | 220 | 28.68 | 1.51 | 0.94 | 6 | 1.54 | 0.49 | | 0.040 | 0.042 | 0.012 | 2.02E-03 | 1.75E+05 | -6.62E+04 | 16655 | (0.23) | (0.23) | 0.00 |
| 68396 | 0.04 | 220 | 21.84 | 1.91 | 1 | 6.88 | 3.18 | 0.62 | | 0.031 | 0.033 | 0.009 | 6.05E-03 | 4.00E+05 | -2.91E+05 | 16355 | (1.36) | (1.36) | 0.00 |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.39 | 10.05 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.005 | 1.64E-02 | 6.68E+05 | -5.59E+05 | 15755 | (4.39) | (4.39) | 0.00 |
| 67396 | 0.04 | 220 | 27.93 | 1.28 | 0.83 | 5.61 | 2.08 | 0.42 | | 0.039 | 0.041 | 0.012 | 2.08E-03 | 1.76E+05 | -6.70E+04 | 15355 | (0.26) | (0.26) | 0.00 |
| 66996 | 0.04 | 220 | 29.36 | 1.69 | 1.01 | 6.28 | 2.14 | 0.55 | | 0.040 | 0.043 | 0.013 | 3.14E-03 | 2.79E+05 | -1.70E+05 | 14955 | (0.64) | (0.64) | 0.00 |
| 66865 | 0.04 | 220 | 17.87 | 0.83 | 0.53 | 4.83 | 2.75 | 0.27 | | 0.026 | 0.028 | 0.007 | 1.59E-03 | 8.60E+04 | 2.31E+04 | 14824 | 0.15 | 0.15 | 0.00 |
| 66850 | 0.04 | 220 | 24.97 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.011 | 8.14E-04 | 6.15E+04 | 4.76E+04 | 14809 | 0.21 | 0.21 | 0.00 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.010 | 2.98E-03 | 2.14E+05 | -1.05E+05 | 14755 | (0.50) | (0.50) | 0.00 |
| 66396 | 0.04 | 220 | 21.6 | 2.08 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.009 | 5.10E-03 | 3.33E+05 | -2.24E+05 | 14355 | (1.20) | (1.20) | 0.00 |
| 66246 | 0.04 | 220 | 25.52 | 0.87 | 0.63 | 4.8 | 3.59 | 0.28 | | 0.036 | 0.038 | 0.011 | 1.96E-03 | 1.51E+05 | -4.24E+04 | 14205 | (0.19) | (0.19) | 0.00 |
| 66245 Vista Regina Bridge | | | | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.98 | 1.01 | 6.98 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.009 | 5.71E-03 | 3.65E+05 | -2.56E+05 | 14175 | (1.42) | (1.42) | 0.00 |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.81 | 1.09 | | 0.038 | 0.040 | 0.012 | 7.65E-03 | 6.33E+05 | -5.24E+05 | 14055 | (2.27) | (2.27) | 0.00 |
| 65796 | 0.04 | 220 | 26.44 | 1.75 | 1 | 6.46 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.011 | 2.70E-03 | 2.16E+05 | -1.07E+05 | 13755 | (0.49) | (0.49) | 0.00 |
| 65196 | 0.04 | 220 | 34.85 | 0.86 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.016 | 9.04E-04 | 9.52E+04 | 1.39E+04 | 13155 | 0.05 | 0.05 | 0.00 |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.98 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.004 | 1.65E-02 | 4.92E+05 | -3.83E+05 | 12555 | (5.15) | (5.15) | 0.00 |
| 63996 | 0.04 | 220 | 17.45 | 1.85 | 0.91 | 6.97 | 2.69 | 0.60 | | 0.026 | 0.027 | 0.007 | 5.47E-03 | 2.89E+05 | -1.80E+05 | 11955 | (1.44) | (1.44) | 0.00 |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.026 | 0.028 | 0.007 | 6.89E-03 | 3.68E+05 | -2.59E+05 | 11655 | (2.10) | (2.10) | 0.00 |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.87 | 0.19 | | 0.032 | 0.034 | 0.009 | 9.67E-04 | 6.61E+04 | 4.29E+04 | 11579 | 0.27 | 0.27 | 0.00 |
| 63596 | 0.04 | 220 | 28.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.013 | 3.93E-04 | 3.44E+04 | 7.47E+04 | 11555 | 0.37 | 0.37 | 0.00 |
| 63396 | 0.04 | 220 | 12.45 | 2.59 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.005 | 1.06E-02 | 3.99E+05 | -2.90E+05 | 11355 | (3.42) | (3.42) | 0.00 |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.05 | 2.48 | 0.85 | | 0.026 | 0.028 | 0.007 | 8.35E-03 | 4.45E+05 | -3.36E+05 | 10755 | (2.95) | (2.95) | 0.00 |
| 62690 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.008 | 2.74E-03 | 1.62E+05 | -5.32E+04 | 10649 | (0.43) | (0.43) | 0.00 |
| 62689 Pierce Rd Bridge | | | | | | | | | | | | | | | | | | | |
| 62662 | 0.04 | 220 | 19.95 | 2.1 | 1.01 | 7.13 | 2 | 0.68 | | 0.029 | 0.031 | 0.008 | 4.57E-03 | 2.76E+05 | -1.67E+05 | 10621 | (1.31) | (1.31) | 0.00 |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.83 | 10.37 | 2.02 | 1.59 | | 0.031 | 0.032 | 0.009 | 1.66E-02 | 1.07E+06 | -9.60E+05 | 10590 | (7.10) | (7.10) | 0.00 |
| 62596 | 0.04 | 220 | 26.38 | 1.99 | 1.09 | 6.82 | 2.05 | 0.65 | | 0.037 | 0.039 | 0.011 | 4.01E-03 | 3.20E+05 | -2.11E+05 | 10555 | (1.26) | (1.26) | 0.00 |
| 62096 | 0.04 | 220 | 47.57 | 0.75 | 0.69 | 4.15 | 1.98 | 0.24 | | 0.061 | 0.065 | 0.022 | 7.13E-04 | 1.03E+05 | 6.59E+03 | 10055 | 0.02 | 0.02 | 0.01 |
| 61696 | 0.04 | 220 | 25.53 | 1.47 | 0.89 | 6.02 | 2.29 | 0.48 | | 0.036 | 0.038 | 0.011 | 2.88E-03 | 2.23E+05 | -1.14E+05 | 9655 | (0.77) | (0.74) | 0.03 |
| 61396 | 0.04 | 220 | 21.95 | 1.05 | 0.68 | 5.31 | 2.68 | 0.34 | | 0.031 | 0.033 | 0.009 | 2.15E-03 | 1.43E+05 | -3.37E+04 | 9355 | (0.27) | (0.29) | (0.02) |
| 60896 | 0.04 | 220 | 21.74 | 1.95 | 1.01 | 6.94 | 2.93 | 0.63 | | 0.031 | 0.033 | 0.009 | 5.81E-03 | 3.82E+05 | -2.73E+05 | 8855 | (2.36) | (2.27) | 0.09 |
| 60396 | 0.04 | 220 | 24.98 | 1.03 | 0.7 | 5.19 | 2.97 | 0.33 | | 0.035 | 0.037 | 0.011 | 2.18E-03 | 1.64E+05 | -5.52E+04 | 8355 | (0.44) | 0.41 | 0.03 |
| 59796 | 0.04 | 220 | 17.43 | 1.35 | 0.74 | 8.06 | 4.16 | 0.44 | | 0.026 | 0.027 | 0.007 | 4.95E-03 | 2.61E+05 | -1.52E+05 | 7755 | (1.87) | (0.56) | 1.31 |
| 59500 | 0.04 | 220 | 19.38 | 2.04 | 1 | 7.17 | 3.16 | 0.66 | | 0.028 | 0.030 | 0.008 | 6.93E-03 | 4.06E+05 | -2.97E+05 | 7459 | (3.43) | (1.09) | 2.34 |
| 59396 | 0.04 | 220 | 36.63 | 0.47 | 0.48 | 3.53 | 3.41 | 0.15 | | 0.049 | 0.052 | 0.017 | 6.56E-04 | 7.27E+04 | 3.64E+04 | 7355 | 0.23 | 0.34 | (0.12) |
| 59300 | 0.04 | 220 | 19.28 | 2.05 | 1.01 | 7.2 | 3.17 | 0.67 | | 0.028 | 0.030 | 0.008 | 7.05E-03 | 4.11E+05 | -3.02E+05 | 7259 | (3.60) | 0.29 | 3.31 |
| 59100 | 0.04 | 220 | 34.89 | 0.6 | 0.55 | 3.93 | 3.13 | 0.19 | | 0.047 | 0.049 | 0.016 | 8.80E-04 | 9.28E+04 | 1.63E+04 | 7059 | 0.11 | (0.96) | (0.85) |
| 59096 | 0.04 | 220 | 19.8 | 1.36 | 0.78 | 6 | 2.79 | 0.44 | | 0.029 | 0.030 | 0.008 | 3.38E-03 | 2.03E+05 | -9.35E+04 | 7055 | (1.12) | 0.51 | 0.61 |
| 59036 | 0.04 | 220 | 20.32 | 1.13 | 0.69 | 5.52 | 2.96 | 0.37 | | 0.029 | 0.031 | 0.008 | 2.68E-03 | 1.65E+05 | -5.55E+04 | 6995 | (0.65) | 0.33 | 0.32 |
| 59035 Corner Drive Bridge | | | | | | | | | | | | | | | | | | | |
| 59000 | 0.04 | 220 | 16.22 | 2.24 | 1.01 | 7.63 | 2.49 | 0.73 | 1.46 | 0.024 | 0.026 | 0.006 | 6.97E-03 | 3.42E+05 | -2.33E+05 | 6959 | (3.44) | (0.06) | 3.38 |
| 58911 | 0.04 | 220 | 33.09 | 1.09 | 0.79 | 5.11 | 2.47 | 0.35 | 0.71 | 0.045 | 0.047 | 0.015 | 1.76E-03 | 1.76E+05 | -6.68E+04 | 6870 | (0.49) | 0.16 | 0.33 |
| 58822 | 0.04 | 220 | 32.8 | 1.61 | 1.01 | 6.06 | 1.89 | 0.52 | 1.05 | 0.044 | 0.047 | 0.015 | 2.50E-03 | 2.48E+05 | -1.39E+05 | 6781 | (1.04) | (0.09) | 0.95 |
| 58733 | 0.04 | 220 | 50.8 | 0.18 | 0.28 | 2.23 | 2.72 | 0.06 | 0.12 | 0.065 | 0.068 | 0.024 | 1.12E-04 | 1.72E+04 | 9.19E+04 | 6692 | 0.45 | (0.43) | 0.02 |
| 58708 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | | 0.054 | 0.057 | 0.019 | 7.79E-05 | 9.75E+03 | 9.93E+04 | 6667 | 0.60 | 0.60 | 0.00 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.36 | 2.09 | 0.37 | 0.75 | 0.039 | 0.041 | 0.012 | 1.79E-03 | 1.51E+05 | -4.19E+04 | 6617 | (0.38) | (0.38) | 0.00 |
| 58608 | 0.04 | 220 | 29.17 | 1.08 | 0.76 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.013 | 1.62E-03 | 1.43E+05 | -3.38E+04 | 6567 | (0.29) | (0.29) | 0.00 |
| 58508 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.59 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 1.23E-03 | 1.39E+05 | -3.02E+04 | 6467 | (0.21) | (0.21) | 0.00 |
| 58308 | 0.04 | 220 | 23.85 | 0.96 | 0.66 | 5.06 | 2.65 | 0.31 | 0.62 | 0.034 | 0.036 | 0.010 | 1.81E-03 | 1.30E+05 | -2.12E+04 | 6267 | (0.24) | (0.24) | 0.00 |
| 58108 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.81 | 0.58 | 2.63 | 0.035 | 0.037 | 0.011 | 3.22E-03 | 2.42E+05 | -1.33E+05 | 6067 | (1.47) | (1.47) | 0.00 |
| 57975 | 0.04 | 220 | 21.89 | 0.58 | 0.46 | 4.08 | 2.77 | 0.19 | 0.38 | 0.031 | 0.033 | 0.009 | 8.99E-04 | 5.95E+04 | 4.96E+04 | 5934 | 0.64 | 0.64 | 0.00 |
| 57804 | 0.07 | 220 | 31.34 | 0.67 | 0.28 | 2.58 | 3.46 | 0.22 | 0.44 | 0.026 | 0.093 | 0.042 | 2.28E-04 | 2.16E+04 | 8.75E+04 | 5763 | 0.81 | 0.81 | (0.00) |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.17 | 0.028 | 0.098 | 0.046 | 1.22E-04 | 1.23E+04 | 9.68E+04 | 5578 | 0.87 | 0.87 | 0.00 |
| 57558 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.56 | 4.76 | 0.20 | 0.33 | 0.022 | 0.077 | 0.033 | 2.92E-04 | 2.24E+04 | 8.66E+04 | 5517 | 1.03 | 1.03 | 0.00 |
| 57509 | 0.07 | 220 | 33.38 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | 0.10 | 0.028 | 0.098 | 0.046 | 8.77E-05 | 8.85E+03 | 1.00E+05 | 5468 | 0.92 | 0.92 | (0.00) |
| 57388 | 0.7 | 220 | 35.55 | 15.58 | 0.11 | 1.34 | 5.34 | 5.06 | | 0.004 | 1.994 | 4.907 | 3.53E-05 | 3.79E+03 | 1.05E+05 | 5347 | 0.92 | 0.92 | 0.00 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 1.00 | 0.026 | 0.091 | 0.041 | 4.53E-04 | 4.20E+04 | 6.71E+04 | 5147 | 0.71 | 0.71 | 0.00 |
| 57058 | 0.07 | 220 | 21.68 | 1.99 | 0.49 | 4.3 | 2.85 | 0.65 | 2.91 | 0.019 | 0.068 | 0.028 | 1.10E-03 | 7.23E+04 | 3.68E+04 | 5017 | 0.56 | 0.56 | 0.00 |
| 56979 | 0.07 | 220 | 26.76 | 1.23 | 0.39 | 3.41 | 2.91 | 0.40 | 4.80 | 0.023 | 0.081 | 0.035 | 5.08E-04 | 4.11E+04 | 6.80E+04 | 4938 | 0.86 | 0.86 | (0.00) |
| 56776 | 0.07 | 220 | 23.14 | 2.13 | 0.53 | 4.4 | 2.57 | 0.69 | 3.11 | 0.020 | 0.071 | 0.030 | 1.09E-03 | 7.64E+04 | 3.27E+04 | 4735 | 0.50 | 0.46 | 0.04 |
| 56731 | 0.02 | 220 | 17.95 | 0.34 | 0.74 | 6.01 | 2.04 | 0.11 | 0.11 | 0.048 | 0.011 | 0.002 | 2.59E-03 | 1.41E+05 | -3.17E+04 | 4690 | (0.63) | (0.63) | 0.00 |
| Average | | | | | | | | | | | | 0.048 | | | | | | | |
| 56730 Wardell Bridge | | | | | | | | | | | | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.55 | 1 | 7.36 | 1.67 | 0.18 | | 0.048 | 0.011 | 0.002 | 4.36E-03 | 2.37E+05 | -1.27E+05 | 4665 | (2.54) | (2.54) | 0.00 |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.99 | 5.84 | | 0.019 | 0.067 | 0.027 | 1.16E-02 | 7.47E+05 | -6.38E+05 | 4629 | (10.80) | (10.80) | 0.00 |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.30 | | 0.022 | 0.077 | 0.033 | 3.66E-04 | 2.79E+04 | 8.12E+04 | 4584 | 1.17 | 1.17 | 0.00 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.27 | | 0.019 | 0.065 | 0.026 | 4.48E-04 | 2.82E+04 | 8.09E+04 | 4555 | 1.42 | 1.42 | 0.00 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.38 | 3.62 | 3.46 | 0.43 | | 0.019 | 0.066 | 0.027 | 7.25E-04 | 4.63E+04 | 6.28E+04 | 4533 | 1.09 | 1.09 | 0.00 |
| 56474 | 0.07 | 220 | 21.19 | 1.39 | 0.39 | 3.68 | 3.39 | 0.45 | | 0.019 | 0.066 | 0.027 | 7.53E-04 | 4.82E+04 | 6.08E+04 | 4433 | 1.08 | 1.08 | 0.00 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.06 | 2.88 | 0.58 | | 0.020 | 0.072 | 0.030 | 9.15E-04 | 6.41E+04 | 4.50E+04 | 4234 | 0.77 | 0.77 | 0.00 |
| 56200 | 0.07 | 220 | 34.8 | 0.39 | 0.2 | 2.01 | 3.55 | 0.13 | | 0.029 | 0.101 | 0.048 | 9.91E-05 | 1.04E+04 | 9.87E+04 | 4159 | 1.14 | 1.14 | 0.00 |
| 56100 | 0.07 | 220 | 27.95 | 0.67 | 0.26 | 2.6 | 3.61 | 0.22 | | 0.024 | 0.084 | 0.037 | 2.42E-04 | 2.05E+04 | 8.86E+04 | 4059 | 1.30 | 1.30 | 0.00 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.44 | | 0.017 | 0.060 | 0.023 | 8.74E-04 | 4.96E+04 | 5.95E+04 | 4033 | 1.31 | 1.31 | 0.00 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.86 | 3.98 | 0.49 | | 0.017 | 0.059 | 0.023 | 1.02E-03 | 5.67E+04 | 5.24E+04 | 4017 | 1.18 | 1.18 | 0.00 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.89 | 0.49 | | 0.021 | 0.074 | 0.031 | 7.12E-04 | 5.16E+04 | 5.75E+04 | 3959 | 1.01 | 1.01 | 0.00 |
| 55902 | 0.07 | 220 | 20.8 | 1.2 | 0.35 | 3.47 | 3.85 | 0.39 | | 0.019 | 0.065 | 0.026 | 6.88E-04 | 4.33E+04 | 6.58E+04 | 3861 | 1.37 | 1.37 | 0.00 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.48 | | 0.019 | 0.066 | 0.027 | 8.90E-04 | 5.70E+04 | 5.21E+04 | 3831 | 1.07 | 1.07 | 0.00 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.53 | | 0.019 | 0.067 | 0.027 | 9.21E-04 | 5.95E+04 | 4.95E+04 | 3759 | 1.03 | 1.03 | 0.00 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.65 | | 0.019 | 0.065 | 0.026 | 1.21E-03 | 7.57E+04 | 3.34E+04 | 3665 | 0.73 | 0.73 | 0.00 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.30 | | 0.019 | 0.067 | 0.027 | 5.08E-04 | 3.29E+04 | 7.62E+04 | 3565 | 1.66 | 1.66 | 0.00 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 1.22 | | 0.015 | 0.051 | 0.019 | 2.94E-03 | 1.40E+05 | -3.04E+04 | 3517 | (0.92) | (0.92) | 0.00 |
| 55505 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.20 | | 0.023 | 0.081 | 0.035 | 2.28E-04 | 1.84E+04 | 9.07E+04 | 3464 | 1.64 | 1.64 | 0.00 |
| 55405 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.40 | | 0.018 | 0.062 | 0.024 | 7.10E-04 | 4.17E+04 | 6.74E+04 | 3364 | 1.72 | 1.72 | 0.00 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.32 | | 0.020 | 0.072 | 0.030 | 5.05E-04 | 3.55E+04 | 7.36E+04 | 3265 | 1.62 | 1.62 | 0.00 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 0.40 | | 0.023 | 0.080 | 0.035 | 6.01E-04 | 4.81E+04 | 6.10E+04 | 3165 | 1.21 | 1.21 | 0.00 |
| 55108 | 0.07 | 220 | 17.94 | 1.78 | 0.43 | 4.16 | 4.02 | 0.58 | | 0.016 | 0.057 | 0.022 | 1.33E-03 | 7.20E+04 | 3.71E+04 | 3067 | 1.12 | 1.12 | 0.00 |
| 55005 | 0.07 | 220 | 23.25 | 1.18 | 0.36 | 3.4 | 3.48 | 0.38 | | 0.020 | 0.072 | 0.030 | 5.88E-04 | 4.13E+04 | 6.78E+04 | 2964 | 1.64 | 1.64 | 0.00 |
| 54905 | 0.07 | 220 | 22.93 | 1.34 | 0.39 | 3.6 | 3.03 | 0.44 | | 0.020 | 0.071 | 0.030 | 6.34E-04 | 4.39E+04 | 6.52E+04 | 2864 | 1.65 | 1.65 | 0.00 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.96 | 3.38 | 0.29 | | 0.022 | 0.076 | 0.033 | 3.57E-04 | 2.69E+04 | 8.22E+04 | 2764 | 1.99 | 1.99 | 0.00 |
| 54705 | 0.07 | 220 | 34.9 | 0.66 | 0.28 | 2.53 | 3.11 | 0.21 | | 0.029 | 0.102 | 0.048 | 1.94E-04 | 2.05E+04 | 8.86E+04 | 2664 | 1.59 | 1.59 | 0.00 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.75 | | 0.018 | 0.064 | 0.025 | 1.55E-03 | 9.46E+04 | 1.44E+04 | 2555 | 0.47 | 0.47 | 0.00 |
| 54511 | 0.07 | 220 | 24.21 | 2.76 | 0.63 | 4.9 | 2.78 | 0.90 | | 0.021 | 0.074 | 0.031 | 1.69E-03 | 1.24E+05 | -1.45E+04 | 2470 | (0.40) | (0.40) | 0.00 |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.45 | 2.21 | 0.10 | | 0.060 | 0.008 | 0.001 | 5.80E-03 | 3.05E+05 | -1.95E+05 | 2455 | (7.64) | (7.64) | 0.00 |
| 54440 | 0.015 | 220 | 13.78 | 0.23 | 0.77 | 6.74 | 2.56 | 0.07 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 1.95E+05 | -8.57E+04 | 2399 | (4.32) | (4.32) | 0.00 |
| 54431 | 0.015 | 220 | 12.96 | 0.23 | 0.74 | 6.7 | 2.54 | 0.07 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 1.78E+05 | -6.92E+04 | 2390 | (3.72) | (3.72) | 0.00 |
| 54430 RR Bridge | | | | | | | | | | | | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 8.23 | 2.08 | 0.12 | | 0.046 | 0.006 | 0.001 | 7.73E-03 | 3.01E+05 | -1.92E+05 | 2355 | (10.54) | (10.54) | 0.00 |
| 54305 | 0.07 | 220 | 22.04 | 20.68 | 2.26 | 11.8 | 0.94 | 6.72 | | 0.020 | 0.069 | 0.028 | 1.33E-02 | 8.87E+05 | -7.78E+05 | 2264 | (25.99) | (25.99) | 0.00 |
| 54296 | 0.07 | 220 | 24.45 | 5.68 | 1 | 6.62 | 2.57 | 1.85 | | 0.021 | 0.075 | 0.032 | 4.41E-03 | 3.26E+05 | -2.17E+05 | 2255 | (6.56) | (6.56) | 0.00 |

# Table G.4
## Alternative 3
## Sediment Analysis Summary

**Input Values**

| Factors | |
|---|---|
| Ks | 0.03 |
| Ku | 1.486 |
| K(mpm) | 60.1 |
| Unit Weight H20 | 62.4 |
| Unit Weight SEC | 165 |
| D90 (mm) | 250 |
| D90 (ft) | 0.820 |
| D50 (mm) | 110.0 |
| D50 (ft) | 0.361 |

| Exponents | |
|---|---|
| a | 3.036E-06 |
| b | 3.419 |
| c | 0.867 |

**Upstream Sediment Supply**

Based on estimate of sed supply from USGS 1975 Report

| | | |
|---|---|---|
| Est. total | 9000 | tons |
| Sed Loading Period | 35 | days |
| Time Δt | 3024000 | sec |
| Sed Volume | 1.09E+05 | cu. ft. |
| $Q_s$ | 0.036 | cfs |
| Prospect Rd Sta | 52041 | |

Assume Sed Load from 3 or 4 Major Storms in Water Year

Assume Sediment Porosity 0.4

| RAS Input Data<br>River Sta | Mann Wtd Chnl | Q Channel (cfs) | 2.3Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3 Yr Max Chl Dpth (ft) | Incipient Motion (ft) | Comer to Wardell Depth to Armor (ft) | Eq Slope Shields (No Sed Supply) (ft/ft) | Eq Slope (MP-M) (No Sed Supply) (ft/ft) | Eq Slope (Regression) (Sed Supply) (ft/ft) | Transport Capacity $q_s = aV^bY^c$ ($ft^2/s$) | Sediment Outflow $q_sW\Delta t$ ($ft^3$) | Net Change ΔV= Supply - Outflow ($ft^3$) | Distance to Prospect Rd. (ft) | Alt. 3 Base El. Change ΔZ (ft) | ExCond Base El. Change DZ (ft) | Alt 2 ΔZ - ExCond ΔZ Delta (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69696 | 0.04 | 220 | 9.39 | 3.09 | 1.01 | 9.15 | 3.59 | 1.00 | | 0.015 | 0.016 | 0.003 | 1.78E-02 | 5.06E+05 | -3.97E+05 | 17655 | (3.99) | (3.99) | 0.00 |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.16 | 8.12 | 2.19 | 0.85 | | 0.026 | 0.028 | 0.007 | 7.72E-03 | 4.13E+05 | -3.04E+05 | 17455 | (1.64) | (1.64) | 0.00 |
| 69196 | 0.04 | 220 | 30.87 | 1.18 | 0.82 | 5.34 | 2.01 | 0.38 | | 0.042 | 0.045 | 0.014 | 1.71E-03 | 1.60E+05 | -5.05E+04 | 17155 | (0.16) | (0.16) | 0.00 |
| 68696 | 0.04 | 220 | 28.68 | 1.51 | 0.94 | 6 | 1.54 | 0.49 | | 0.040 | 0.042 | 0.012 | 2.02E-03 | 1.75E+05 | -6.62E+04 | 16655 | (0.23) | (0.23) | 0.00 |
| 68396 | 0.04 | 220 | 21.84 | 1.91 | 1 | 6.88 | 3.18 | 0.62 | | 0.031 | 0.033 | 0.009 | 6.05E-03 | 4.00E+05 | -2.91E+05 | 16355 | (1.36) | (1.36) | 0.00 |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.39 | 10.05 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.005 | 1.64E-02 | 6.68E+05 | -5.59E+05 | 15755 | (4.39) | (4.39) | 0.00 |
| 67396 | 0.04 | 220 | 27.93 | 1.28 | 0.83 | 5.61 | 2.08 | 0.42 | | 0.039 | 0.041 | 0.012 | 2.08E-03 | 1.76E+05 | -6.70E+04 | 15355 | (0.26) | (0.26) | 0.00 |
| 66996 | 0.04 | 220 | 29.36 | 1.69 | 1.01 | 6.28 | 2.14 | 0.55 | | 0.040 | 0.043 | 0.013 | 3.14E-03 | 2.79E+05 | -1.70E+05 | 14955 | (0.64) | (0.64) | 0.00 |
| 66865 | 0.04 | 220 | 17.87 | 0.83 | 0.53 | 4.83 | 2.75 | 0.27 | | 0.026 | 0.028 | 0.007 | 1.59E-03 | 8.60E+04 | 2.31E+04 | 14824 | 0.15 | 0.15 | 0.00 |
| 66850 | 0.04 | 220 | 24.97 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.011 | 8.14E-04 | 6.15E+04 | 4.76E+04 | 14809 | 0.21 | 0.21 | 0.00 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.010 | 2.98E-03 | 2.14E+05 | -1.05E+05 | 14755 | (0.50) | (0.50) | 0.00 |
| 66396 | 0.04 | 220 | 21.6 | 2.08 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.009 | 5.10E-03 | 3.33E+05 | -2.24E+05 | 14355 | (1.20) | (1.20) | 0.00 |
| 66246 | 0.04 | 220 | 25.52 | 0.87 | 0.63 | 4.8 | 3.59 | 0.28 | | 0.036 | 0.038 | 0.011 | 1.96E-03 | 1.51E+05 | -4.24E+04 | 14205 | (0.19) | (0.19) | 0.00 |
| 66245 Bridge | | | | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.98 | 1.01 | 6.98 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.009 | 5.71E-03 | 3.65E+05 | -2.56E+05 | 14175 | (1.42) | (1.42) | 0.00 |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.81 | 1.09 | | 0.038 | 0.040 | 0.012 | 7.65E-03 | 6.33E+05 | -5.24E+05 | 14055 | (2.27) | (2.27) | 0.00 |
| 65796 | 0.04 | 220 | 26.44 | 1.75 | 1 | 6.46 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.011 | 2.70E-03 | 2.16E+05 | -1.07E+05 | 13755 | (0.49) | (0.49) | 0.00 |
| 65196 | 0.04 | 220 | 34.85 | 0.86 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.016 | 9.04E-04 | 9.52E+04 | 1.39E+04 | 13155 | 0.05 | 0.05 | 0.00 |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.98 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.004 | 1.65E-02 | 4.92E+05 | -3.83E+05 | 12555 | (5.15) | (5.15) | 0.00 |
| 63996 | 0.04 | 220 | 17.45 | 1.85 | 0.91 | 6.97 | 2.69 | 0.60 | | 0.026 | 0.027 | 0.007 | 5.47E-03 | 2.89E+05 | -1.80E+05 | 11955 | (1.44) | (1.44) | 0.00 |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.026 | 0.028 | 0.007 | 6.89E-03 | 3.68E+05 | -2.59E+05 | 11655 | (2.10) | (2.10) | 0.00 |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.87 | 0.19 | | 0.032 | 0.034 | 0.009 | 9.67E-04 | 6.61E+04 | 4.29E+04 | 11579 | 0.27 | 0.27 | 0.00 |
| 63596 | 0.04 | 220 | 28.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.013 | 3.93E-04 | 3.44E+04 | 7.47E+04 | 11555 | 0.37 | 0.37 | 0.00 |
| 63396 | 0.04 | 220 | 12.45 | 2.59 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.005 | 1.06E-02 | 3.99E+05 | -2.90E+05 | 11355 | (3.42) | (3.42) | 0.00 |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.05 | 2.48 | 0.85 | | 0.026 | 0.028 | 0.007 | 8.35E-03 | 4.45E+05 | -3.36E+05 | 10755 | (2.95) | (2.95) | 0.00 |
| 62690 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.008 | 2.74E-03 | 1.62E+05 | -5.32E+04 | 10649 | (0.43) | (0.43) | 0.00 |
| 62689 Bridge | | | | | | | | | | | | | | | | | | | |
| 62662 | 0.04 | 220 | 19.95 | 2.1 | 1.01 | 7.13 | 2 | 0.68 | | 0.029 | 0.031 | 0.008 | 4.57E-03 | 2.76E+05 | -1.67E+05 | 10621 | (1.31) | (1.31) | 0.00 |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.83 | 10.37 | 2.02 | 1.59 | | 0.031 | 0.032 | 0.009 | 1.66E-02 | 1.07E+06 | -9.60E+05 | 10590 | (7.10) | (7.10) | 0.00 |
| 62596 | 0.04 | 220 | 26.38 | 1.99 | 1.09 | 6.82 | 2.05 | 0.65 | | 0.037 | 0.039 | 0.011 | 4.01E-03 | 3.20E+05 | -2.11E+05 | 10555 | (1.26) | (1.26) | 0.00 |
| 62096 | 0.04 | 220 | 47.48 | 0.76 | 0.7 | 4.17 | 1.98 | 0.25 | | 0.061 | 0.064 | 0.022 | 7.24E-04 | 1.04E+05 | 5.09E+03 | 10055 | 0.02 | 0.02 | 0.00 |
| 61696 | 0.04 | 220 | 25.73 | 1.45 | 0.88 | 5.97 | 2.3 | 0.47 | | 0.036 | 0.038 | 0.011 | 2.81E-03 | 2.19E+05 | -1.10E+05 | 9655 | (0.74) | (0.74) | 0.00 |
| 61396 | 0.04 | 220 | 21.9 | 1.06 | 0.69 | 5.34 | 2.67 | 0.34 | | 0.031 | 0.033 | 0.009 | 2.19E-03 | 1.45E+05 | -3.57E+04 | 9355 | (0.29) | (0.29) | 0.00 |
| 60896 | 0.04 | 220 | 21.85 | 1.91 | 1 | 6.87 | 2.95 | 0.62 | | 0.031 | 0.033 | 0.009 | 5.64E-03 | 3.73E+05 | -2.64E+05 | 8855 | (2.27) | (2.27) | 0.00 |
| 60396 | 0.04 | 220 | 39.21 | 0.26 | 0.33 | 2.69 | 3.03 | 0.08 | | 0.052 | 0.055 | 0.018 | 2.34E-04 | 2.77E+04 | 8.13E+04 | 8355 | 0.41 | 0.41 | 0.00 |
| 59796 | 0.04 | 220 | 39.94 | 1.29 | 0.93 | 5.35 | 2.08 | 0.42 | | 0.053 | 0.056 | 0.018 | 1.77E-03 | 2.14E+05 | -1.05E+05 | 7755 | (0.56) | (0.56) | 0.00 |
| 59500 | 0.04 | 220 | 25.34 | 1.79 | 1 | 6.56 | 1.73 | 0.58 | | 0.036 | 0.038 | 0.011 | 3.03E-03 | 2.32E+05 | -1.23E+05 | 7459 | (1.09) | (1.09) | 0.00 |
| 59396 | 0.04 | 220 | 43.72 | 2.2 | 1.35 | 6.65 | 1.51 | 0.71 | | 0.057 | 0.060 | 0.020 | 2.82E-03 | 3.73E+05 | -2.64E+05 | 7355 | (1.37) | 0.34 | 1.03 |
| 59300 | 0.04 | 220 | 25.88 | 1.87 | 1.04 | 6.68 | 2.28 | 0.61 | | 0.036 | 0.038 | 0.011 | 4.10E-03 | 3.21E+05 | -2.12E+05 | 7259 | (1.88) | 0.29 | 1.59 |
| 59100 | 0.04 | 220 | 36.76 | 0.76 | 0.64 | 4.31 | 2.58 | 0.25 | | 0.049 | 0.052 | 0.017 | 1.02E-03 | 1.13E+05 | -4.31E+03 | 7059 | (0.03) | (0.96) | (0.93) |
| 59096 | 0.04 | 220 | 21.66 | 1.77 | 0.95 | 6.65 | 2.19 | 0.58 | | 0.031 | 0.033 | 0.009 | 3.90E-03 | 2.55E+05 | -1.46E+05 | 7055 | (1.60) | 0.51 | 1.09 |
| 59036 | 0.04 | 220 | 23.69 | 0.78 | 0.58 | 4.62 | 3.01 | 0.25 | | 0.034 | 0.036 | 0.010 | 1.48E-03 | 1.07E+05 | 2.28E+03 | 6995 | 0.02 | 0.33 | (0.30) |
| 59035 Comer Bridge | | | | | | | | | | | | | | | | | | | |
| 59000 | 0.04 | 220 | 21.41 | 1.27 | 0.76 | 5.77 | 2.49 | 0.41 | 0.83 | 0.031 | 0.033 | 0.009 | 2.68E-03 | 1.74E+05 | -6.46E+04 | 6959 | (0.72) | (0.06) | 0.66 |
| 58911 | 0.04 | 220 | 43.97 | 0.92 | 0.77 | 4.56 | 1.49 | 0.30 | 0.60 | 0.057 | 0.060 | 0.021 | 7.69E-04 | 1.02E+05 | 6.90E+03 | 6870 | 0.04 | 0.16 | (0.12) |
| 58822 | 0.04 | 220 | 37.6 | 0.58 | 0.55 | 3.84 | 1.86 | 0.19 | | 0.050 | 0.053 | 0.017 | 5.18E-04 | 5.89E+04 | 5.02E+04 | 6781 | 0.33 | (0.09) | 0.24 |
| 58733 | 0.04 | 220 | 51.73 | 0.14 | 0.24 | 1.99 | 2.8 | 0.05 | 0.09 | 0.066 | 0.069 | 0.025 | 7.80E-05 | 1.22E+04 | 9.69E+04 | 6692 | 0.47 | (0.43) | 0.04 |
| 58708 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | 0.08 | 0.054 | 0.057 | 0.019 | 7.79E-05 | 9.75E+03 | 9.93E+04 | 6667 | 0.60 | 0.60 | 0.00 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.36 | 2.09 | 0.37 | 1.68 | 0.039 | 0.041 | 0.012 | 1.79E-03 | 1.51E+05 | -4.19E+04 | 6617 | (0.38) | (0.38) | 0.00 |
| 58608 | 0.04 | 220 | 29.17 | 1.08 | 0.76 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.013 | 1.62E-03 | 1.43E+05 | -3.38E+04 | 6567 | (0.29) | (0.29) | 0.00 |
| 58508 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.59 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 1.23E-03 | 1.39E+05 | -3.02E+04 | 6467 | (0.21) | (0.21) | 0.00 |
| 58308 | 0.04 | 220 | 23.85 | 0.96 | 0.66 | 5.06 | 2.65 | 0.31 | 0.40 | 0.034 | 0.036 | 0.010 | 1.81E-03 | 1.30E+05 | -2.12E+04 | 6267 | (0.24) | (0.24) | 0.00 |
| 58108 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.81 | 0.58 | 0.94 | 0.035 | 0.037 | 0.011 | 3.22E-03 | 2.42E+05 | -1.33E+05 | 6067 | (1.47) | (1.47) | 0.00 |
| 57975 | 0.04 | 220 | 21.89 | 0.58 | 0.46 | 4.08 | 2.77 | 0.19 | 0.19 | 0.031 | 0.033 | 0.009 | 8.99E-04 | 5.95E+04 | 4.96E+04 | 5934 | 0.64 | 0.64 | 0.00 |
| 57804 | 0.07 | 220 | 31.34 | 0.67 | 0.28 | 2.58 | 3.46 | 0.22 | | 0.026 | 0.093 | 0.042 | 2.28E-04 | 2.16E+04 | 8.75E+04 | 5763 | 0.81 | 0.81 | (0.00) |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.32 | 0.028 | 0.098 | 0.046 | 1.22E-04 | 1.23E+04 | 9.68E+04 | 5578 | 0.87 | 0.87 | 0.00 |
| 57558 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.56 | 4.76 | 0.20 | 0.92 | 0.022 | 0.077 | 0.033 | 2.92E-04 | 2.24E+04 | 8.66E+04 | 5517 | 1.03 | 1.03 | 0.00 |
| 57509 | 0.07 | 220 | 33.38 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | 1.21 | 0.028 | 0.098 | 0.046 | 8.77E-05 | 8.85E+03 | 1.00E+05 | 5468 | 0.92 | 0.92 | (0.00) |
| 57388 | 0.7 | 220 | 35.55 | 15.58 | 0.11 | 1.34 | 5.34 | 5.06 | 22.78 | 0.004 | 1.994 | 4.907 | 3.53E-05 | 3.79E+03 | 1.05E+05 | 5347 | 0.92 | 0.92 | 0.00 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 0.41 | 0.026 | 0.091 | 0.041 | 4.53E-04 | 4.20E+04 | 6.71E+04 | 5147 | 0.71 | 0.71 | 0.00 |
| 57058 | 0.07 | 220 | 21.68 | 1.99 | 0.49 | 4.3 | 2.85 | 0.65 | | 0.019 | 0.068 | 0.028 | 1.10E-03 | 7.23E+04 | 3.68E+04 | 5017 | 0.56 | 0.56 | 0.00 |
| 56979 | 0.07 | 220 | 26.76 | 1.23 | 0.39 | 3.41 | 2.91 | 0.40 | | 0.023 | 0.081 | 0.035 | 5.08E-04 | 4.11E+04 | 6.80E+04 | 4938 | 0.86 | 0.86 | (0.00) |
| 56776 | 0.07 | 220 | 23.14 | 2.13 | 0.53 | 4.4 | 2.57 | 0.69 | | 0.020 | 0.071 | 0.030 | 1.09E-03 | 7.64E+04 | 3.27E+04 | 4735 | 0.50 | 0.46 | 0.04 |
| 56731 | 0.02 | 220 | 17.95 | 0.34 | 0.74 | 6.01 | 2.04 | 0.11 | | 0.048 | 0.011 | 0.002 | 2.59E-03 | 1.41E+05 | -3.17E+04 | 4690 | (0.63) | (0.63) | 0.00 |
| 56730 Wardell Bridge | | | | | | | | | | | | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.55 | 1 | 7.36 | 1.67 | 0.40 | | 0.048 | 0.011 | 0.002 | 4.36E-03 | 2.37E+05 | -1.27E+05 | 4665 | (2.54) | (2.54) | 0.00 |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.99 | 0.69 | | 0.019 | 0.067 | 0.027 | 1.16E-02 | 7.47E+05 | -6.38E+05 | 4629 | (10.80) | (10.80) | 0.00 |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.11 | | 0.022 | 0.077 | 0.033 | 3.66E-04 | 2.79E+04 | 8.12E+04 | 4584 | 1.17 | 1.17 | 0.00 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.00 | | 0.019 | 0.065 | 0.026 | 4.48E-04 | 2.82E+04 | 8.09E+04 | 4555 | 1.42 | 1.42 | 0.00 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.38 | 3.62 | 3.46 | 0.18 | | 0.019 | 0.066 | 0.027 | 7.25E-04 | 4.63E+04 | 6.28E+04 | 4533 | 1.09 | 1.09 | 0.00 |
| 56474 | 0.07 | 220 | 21.19 | 1.39 | 0.39 | 3.68 | 3.39 | 5.84 | | 0.019 | 0.066 | 0.027 | 7.53E-04 | 4.82E+04 | 6.08E+04 | 4433 | 1.08 | 1.08 | 0.00 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.06 | 2.88 | 0.30 | | 0.020 | 0.072 | 0.030 | 9.15E-04 | 6.41E+04 | 4.50E+04 | 4234 | 0.77 | 0.77 | 0.00 |
| 56200 | 0.07 | 220 | 34.8 | 0.39 | 0.2 | 2.01 | 3.55 | 0.27 | | 0.029 | 0.101 | 0.048 | 9.91E-05 | 1.04E+04 | 9.87E+04 | 4159 | 1.14 | 1.14 | 0.00 |
| 56100 | 0.07 | 220 | 27.95 | 0.67 | 0.26 | 2.6 | 3.61 | 0.43 | | 0.024 | 0.084 | 0.037 | 2.42E-04 | 2.05E+04 | 8.86E+04 | 4059 | 1.30 | 1.30 | 0.00 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.45 | | 0.017 | 0.060 | 0.023 | 8.74E-04 | 4.96E+04 | 5.95E+04 | 4033 | 1.31 | 1.31 | 0.00 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.86 | 3.98 | 0.58 | | 0.017 | 0.059 | 0.023 | 1.02E-03 | 5.67E+04 | 5.24E+04 | 4017 | 1.18 | 1.18 | 0.00 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.89 | 0.13 | | 0.021 | 0.074 | 0.031 | 7.12E-04 | 5.16E+04 | 5.75E+04 | 3959 | 1.01 | 1.01 | 0.00 |
| 55902 | 0.07 | 220 | 20.8 | 1.2 | 0.35 | 3.47 | 3.85 | 0.22 | | 0.019 | 0.065 | 0.026 | 6.88E-04 | 4.33E+04 | 6.58E+04 | 3861 | 1.37 | 1.37 | 0.00 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.44 | | 0.019 | 0.066 | 0.027 | 8.90E-04 | 5.70E+04 | 5.21E+04 | 3831 | 1.07 | 1.07 | 0.00 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.49 | | 0.019 | 0.067 | 0.027 | 9.21E-04 | 5.95E+04 | 4.95E+04 | 3759 | 1.03 | 1.03 | 0.00 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.49 | | 0.019 | 0.065 | 0.026 | 1.21E-03 | 7.57E+04 | 3.34E+04 | 3665 | 0.73 | 0.73 | 0.00 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.39 | | 0.019 | 0.067 | 0.027 | 5.08E-04 | 3.29E+04 | 7.62E+04 | 3565 | 1.66 | 1.66 | 0.00 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 0.48 | | 0.015 | 0.051 | 0.019 | 2.94E-03 | 1.40E+05 | -3.04E+04 | 3517 | (0.92) | (0.92) | 0.00 |
| 55505 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.53 | | 0.023 | 0.081 | 0.035 | 2.28E-04 | 1.84E+04 | 9.07E+04 | 3464 | 1.64 | 1.64 | 0.00 |
| 55405 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.65 | | 0.018 | 0.062 | 0.024 | 7.10E-04 | 4.17E+04 | 6.74E+04 | 3364 | 1.72 | 1.72 | 0.00 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.30 | | 0.020 | 0.072 | 0.030 | 5.05E-04 | 3.55E+04 | 7.36E+04 | 3265 | 1.62 | 1.62 | 0.00 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 1.22 | | 0.023 | 0.080 | 0.035 | 6.01E-04 | 4.81E+04 | 6.10E+04 | 3165 | 1.21 | 1.21 | 0.00 |
| 55108 | 0.07 | 220 | 17.94 | 1.78 | 0.43 | 4.16 | 4.02 | 0.20 | | 0.016 | 0.057 | 0.022 | 1.33E-03 | 7.20E+04 | 3.71E+04 | 3067 | 1.12 | 1.12 | 0.00 |
| 55005 | 0.07 | 220 | 23.25 | 1.18 | 0.36 | 3.4 | 3.48 | 0.40 | | 0.020 | 0.072 | 0.030 | 5.88E-04 | 4.13E+04 | 6.78E+04 | 2964 | 1.64 | 1.64 | 0.00 |
| 54905 | 0.07 | 220 | 22.93 | 1.34 | 0.39 | 3.6 | 3.03 | 0.32 | | 0.020 | 0.071 | 0.030 | 6.34E-04 | 4.39E+04 | 6.52E+04 | 2864 | 1.65 | 1.65 | 0.00 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.96 | 3.38 | 0.40 | | 0.022 | 0.076 | 0.033 | 3.57E-04 | 2.69E+04 | 8.22E+04 | 2764 | 1.99 | 1.99 | 0.00 |
| 54705 | 0.07 | 220 | 34.9 | 0.66 | 0.28 | 2.53 | 3.11 | 0.58 | | 0.029 | 0.102 | 0.048 | 1.94E-04 | 2.05E+04 | 8.86E+04 | 2664 | 1.59 | 1.59 | 0.00 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.38 | | 0.018 | 0.064 | 0.025 | 1.55E-03 | 9.46E+04 | 1.44E+04 | 2555 | 0.47 | 0.47 | 0.00 |
| 54511 | 0.07 | 220 | 24.21 | 2.76 | 0.63 | 4.9 | 2.78 | 0.44 | | 0.021 | 0.074 | 0.031 | 1.69E-03 | 1.24E+05 | -1.45E+04 | 2470 | (0.40) | (0.40) | 0.00 |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.45 | 2.21 | 0.29 | | 0.060 | 0.008 | 0.001 | 5.80E-03 | 3.05E+05 | -1.95E+05 | 2455 | (7.64) | (7.64) | 0.00 |
| 54440 | 0.015 | 220 | 13.78 | 0.23 | 0.77 | 6.74 | 2.56 | 0.21 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 1.95E+05 | -8.57E+04 | 2399 | (4.32) | (4.32) | 0.00 |
| 54431 | 0.015 | 220 | 12.96 | 0.23 | 0.74 | 6.7 | 2.54 | 0.75 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 1.78E+05 | -6.92E+04 | 2390 | (3.72) | (3.72) | 0.00 |
| 54430 Bridge | | | | | | | | | | | | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 8.23 | 2.08 | 0.10 | | 0.046 | 0.006 | 0.001 | 7.73E-03 | 3.01E+05 | -1.92E+05 | 2355 | (10.54) | (10.54) | 0.00 |
| 54305 | 0.07 | 220 | 22.04 | 20.68 | 2.26 | 11.8 | 0.94 | 0.07 | | 0.020 | 0.069 | 0.028 | 1.33E-02 | 8.87E+05 | -7.78E+05 | 2264 | (25.99) | (25.99) | 0.00 |
| 54296 | 0.07 | 220 | 24.45 | 5.68 | 1 | 6.62 | 2.57 | 0.07 | | 0.046 | 0.075 | 0.032 | 4.41E-03 | 3.26E+05 | -2.17E+05 | 2255 | (6.56) | (6.56) | 0.00 |

# Table G.5
# Alternative 4
# Sediment Analysis Summary

**Input Values**

**Factors**

| | |
|---|---|
| Ks | 0.03 |
| Ku | 1.486 |
| K(mpm) | 60.1 |
| Unit Weigl | 62.4 |
| Unit Weigl | 165 |
| D90 (mm) | 250 |
| D90 (ft) | 0.820 |
| D50 (mm) | 110.0 |
| D50 (ft) | 0.361 |

**Upstream Sediment Supply**

Based on estimate of sed supply from USGS 1975 Report

Est total 9000 tons
Sed Loading Period 35 days
Time Δt 3024000 sec

Sed Volume 1.09E+05 cu. ft

$Q_s$ 0.036 cfs

Assume Sed Load from 3 or 4 Major Storms in Water Year

Assume Sediment Porosity 0.4

Exponents
a 3.036E-06
b 3.419
c 0.867

Prospect Rd Sta 52041

**RAS Input Data**

| River Sta | ann Wtd Cl | Q Channel (cfs) | 2.3Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3Yr Max Chl Dpth (ft) | Incipient Motion (ft) | Corner to Wardell Depth to Armor (ft) | Eq Slope Shields (No Sed Supply) (ft/ft) | Eq Slope (MP-M) (No Sed Supply) (ft/ft) | Eq Slope (Regression) (Sed Supply) (ft/ft) | Transport Capacity $qs = aV^bY^c$ $(ft^2/s)$ | Sediment Outflow qsWΔt $(ft^3)$ | Net Change ΔV= Supply - Outflow $(ft^3)$ | Distance to Prospect Rd. (ft) | Alt. 4 Base El. Change ΔZ (ft) | ExCond Base El. Change DZ (ft) | Alt 1 ΔZ - ExCond ΔZ Delta (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69696 | 0.04 | 220 | 9.39 | 3.09 | 1.01 | 9.15 | 3.59 | 1.00 | | 0.015 | 0.016 | 0.003 | 1.78E-02 | 5.06E+05 | -3.97E+05 | 17655 | (3.99) | (3.99) | 0.00 |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.16 | 8.12 | 2.19 | 0.85 | | 0.026 | 0.028 | 0.007 | 7.72E-03 | 4.13E+05 | -3.04E+05 | 17455 | (1.64) | (1.64) | 0.00 |
| 69196 | 0.04 | 220 | 30.87 | 1.18 | 0.82 | 5.34 | 2.01 | 0.38 | | 0.042 | 0.045 | 0.014 | 1.71E-03 | 1.60E+05 | -5.05E+04 | 17155 | (0.16) | (0.16) | 0.00 |
| 68696 | 0.04 | 220 | 28.68 | 1.51 | 0.94 | 6 | 1.54 | 0.49 | | 0.040 | 0.042 | 0.012 | 2.02E-03 | 1.75E+05 | -6.62E+04 | 16655 | (0.23) | (0.23) | 0.00 |
| 68396 | 0.04 | 220 | 21.84 | 1.91 | 1 | 6.88 | 3.18 | 0.62 | | 0.031 | 0.033 | 0.009 | 6.05E-03 | 4.00E+05 | -2.91E+05 | 16355 | (1.36) | (1.36) | 0.00 |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.39 | 10.05 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.005 | 1.64E-02 | 6.68E+05 | -5.59E+05 | 15755 | (4.39) | (4.39) | 0.00 |
| 67396 | 0.04 | 220 | 27.93 | 1.28 | 0.83 | 5.61 | 2.08 | 0.42 | | 0.039 | 0.041 | 0.012 | 2.08E-03 | 1.76E+05 | -6.70E+04 | 15355 | (0.26) | (0.26) | 0.00 |
| 66996 | 0.04 | 220 | 29.36 | 1.69 | 1.01 | 6.28 | 2.14 | 0.55 | | 0.040 | 0.043 | 0.013 | 3.14E-03 | 2.79E+05 | -1.70E+05 | 14955 | (0.64) | (0.64) | 0.00 |
| 66865 | 0.04 | 220 | 17.87 | 0.83 | 0.53 | 4.83 | 2.75 | 0.27 | | 0.026 | 0.028 | 0.007 | 1.59E-03 | 8.60E+04 | 2.31E+04 | 14824 | 0.15 | 0.15 | 0.00 |
| 66850 | 0.04 | 220 | 24.97 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.011 | 8.14E-04 | 6.15E+04 | 4.76E+04 | 14809 | 0.21 | 0.21 | 0.00 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.010 | 2.98E-03 | 2.14E+05 | -1.05E+05 | 14755 | (0.50) | (0.50) | 0.00 |
| 66396 | 0.04 | 220 | 21.6 | 2.08 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.009 | 5.10E-03 | 3.33E+05 | -2.24E+05 | 14355 | (1.20) | (1.20) | 0.00 |
| 66246 | 0.04 | 220 | 25.52 | 0.87 | 0.63 | 4.8 | 3.59 | 0.28 | | 0.036 | 0.038 | 0.011 | 1.96E-03 | 1.51E+05 | -4.24E+04 | 14205 | (0.19) | (0.19) | 0.00 |
| 66245 Vista Regina Bridge | | | | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.98 | 1.01 | 6.98 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.009 | 5.71E-03 | 3.65E+05 | -2.56E+05 | 14175 | (1.42) | (1.42) | 0.00 |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.81 | 1.09 | | 0.038 | 0.040 | 0.012 | 7.65E-03 | 6.33E+05 | -5.24E+05 | 14055 | (2.27) | (2.27) | 0.00 |
| 65796 | 0.04 | 220 | 26.44 | 1.75 | 1 | 6.46 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.011 | 2.70E-03 | 2.16E+05 | -1.07E+05 | 13755 | (0.49) | (0.49) | 0.00 |
| 65196 | 0.04 | 220 | 34.85 | 0.86 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.016 | 9.04E-04 | 9.52E+04 | 1.39E+04 | 13155 | 0.05 | 0.05 | 0.00 |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.98 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.004 | 1.65E-02 | 4.92E+05 | -3.83E+05 | 12555 | (5.15) | (5.15) | 0.00 |
| 63996 | 0.04 | 220 | 17.45 | 1.85 | 0.91 | 6.97 | 2.69 | 0.60 | | 0.026 | 0.027 | 0.007 | 5.47E-03 | 2.89E+05 | -1.80E+05 | 11955 | (1.44) | (1.44) | 0.00 |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.026 | 0.028 | 0.007 | 6.89E-03 | 3.68E+05 | -2.59E+05 | 11655 | (2.10) | (2.10) | 0.00 |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.87 | 0.19 | | 0.032 | 0.034 | 0.009 | 9.67E-04 | 6.61E+04 | 4.29E+04 | 11579 | 0.27 | 0.27 | 0.00 |
| 63596 | 0.04 | 220 | 28.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.013 | 3.93E-04 | 3.44E+04 | 7.47E+04 | 11555 | 0.37 | 0.37 | 0.00 |
| 63396 | 0.04 | 220 | 12.45 | 2.59 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.005 | 1.06E-02 | 3.99E+05 | -2.90E+05 | 11355 | (3.42) | (3.42) | 0.00 |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.05 | 2.48 | 0.85 | | 0.026 | 0.028 | 0.007 | 8.35E-03 | 4.45E+05 | -3.36E+05 | 10755 | (2.95) | (2.95) | 0.00 |
| 62690 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.008 | 2.74E-03 | 1.62E+05 | -5.32E+04 | 10649 | (0.43) | (0.43) | 0.00 |
| 62689 Pierce Rd Bridge | | | | | | | | | | | | | | | | | | | |
| 62662 | 0.04 | 220 | 19.95 | 2.1 | 1.01 | 7.13 | 2 | 0.68 | | 0.029 | 0.031 | 0.008 | 4.57E-03 | 2.76E+05 | -1.67E+05 | 10621 | (1.31) | (1.31) | 0.00 |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.83 | 10.37 | 2.02 | 1.59 | | 0.031 | 0.032 | 0.009 | 1.66E-02 | 1.07E+06 | -9.60E+05 | 10590 | (7.10) | (7.10) | 0.00 |
| 62596 | 0.04 | 220 | 26.38 | 1.99 | 1.09 | 6.82 | 2.05 | 0.65 | | 0.037 | 0.039 | 0.011 | 4.01E-03 | 3.20E+05 | -2.11E+05 | 10555 | (1.26) | (1.26) | 0.00 |
| 62096 | 0.04 | 220 | 47.48 | 0.76 | 0.7 | 4.17 | 1.98 | 0.25 | | 0.061 | 0.064 | 0.022 | 7.24E-04 | 1.04E+05 | 5.09E+03 | 10055 | 0.02 | 0.02 | 0.00 |
| 61696 | 0.04 | 220 | 25.73 | 1.45 | 0.88 | 5.97 | 2.3 | 0.47 | | 0.036 | 0.038 | 0.011 | 2.81E-03 | 2.19E+05 | -1.10E+05 | 9655 | (0.74) | (0.74) | 0.00 |
| 61396 | 0.04 | 220 | 21.9 | 1.06 | 0.69 | 5.34 | 2.67 | 0.34 | | 0.031 | 0.033 | 0.009 | 2.19E-03 | 1.45E+05 | -3.57E+04 | 9355 | (0.29) | (0.29) | 0.00 |
| 60896 | 0.04 | 220 | 21.85 | 1.91 | 1 | 6.87 | 2.95 | 0.62 | | 0.031 | 0.033 | 0.009 | 5.64E-03 | 3.73E+05 | -2.64E+05 | 8855 | (2.27) | (2.27) | 0.00 |
| 60396 | 0.04 | 220 | 39.21 | 0.26 | 0.33 | 2.69 | 3.03 | 0.08 | | 0.052 | 0.055 | 0.018 | 2.34E-04 | 2.77E+04 | 8.13E+04 | 8355 | 0.41 | 0.41 | 0.00 |
| 59796 | 0.04 | 220 | 39.94 | 1.29 | 0.93 | 5.35 | 2.08 | 0.42 | | 0.053 | 0.056 | 0.018 | 1.77E-03 | 2.14E+05 | -1.05E+05 | 7755 | (0.56) | (0.56) | 0.00 |
| 59500 | 0.04 | 220 | 25.34 | 1.79 | 1 | 6.56 | 1.73 | 0.58 | | 0.036 | 0.038 | 0.011 | 3.03E-03 | 2.32E+05 | -1.23E+05 | 7459 | (1.09) | (1.09) | 0.00 |
| 59396 | 0.04 | 220 | 69.53 | 0.05 | 0.14 | 1.26 | 3.89 | 0.02 | | 0.085 | 0.089 | 0.035 | 2.17E-05 | 4.57E+03 | 1.05E+05 | 7355 | 0.34 | 0.34 | 0.00 |
| 59300 | 0.04 | 220 | 43.31 | 0.44 | 0.47 | 3.33 | 2.57 | 0.14 | | 0.056 | 0.060 | 0.020 | 4.21E-04 | 5.51E+04 | 5.40E+04 | 7259 | 0.29 | 0.29 | (0.00) |
| 59100 | 0.04 | 220 | 38.13 | 1.53 | 1.02 | 5.77 | 2.06 | 0.50 | | 0.050 | 0.053 | 0.017 | 2.28E-03 | 2.62E+05 | -1.53E+05 | 7059 | (0.95) | (0.96) | (0.01) |
| 59096 | 0.04 | 220 | 27.15 | 6.77 | 2.42 | 11.52 | 0.93 | 2.20 | | 0.038 | 0.040 | 0.012 | 1.21E-02 | 9.97E+05 | -8.88E+05 | 7055 | (7.73) | 0.51 | 7.22 |
| 59092 | 0.04 | 220 | 21.01 | 7.9 | 2.48 | 12.76 | 0.99 | 2.57 | | 0.030 | 0.032 | 0.009 | 1.82E-02 | 1.16E+06 | -1.05E+06 | 7051 | (11.77) | 0.33 | 11.45 |
| 59036 | 0.04 | 220 | 31.22 | 0.87 | 0.66 | 4.63 | 1.54 | | | | | | | | | | | | |
| 59035 Corner Drive Bridge | | | | | | | | | | | | | | | | | | | |
| 59000 | 0.04 | 220 | 31.11 | 0.93 | 0.69 | 4.78 | 1.49 | 0.30 | 0.60 | 0.042 | 0.045 | 0.014 | 9.03E-04 | 8.49E+04 | 2.41E+04 | 6959 | 0.19 | (0.06) | 0.12 |
| 58911 | 0.04 | 220 | 37.92 | 0.89 | 0.72 | 4.59 | 1.43 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 7.58E-04 | 8.70E+04 | 2.21E+04 | 6870 | 0.14 | 0.16 | (0.02) |
| 58822 | 0.04 | 220 | 40.47 | 0.63 | 0.59 | 3.93 | 1.57 | 0.20 | 0.41 | 0.053 | 0.056 | 0.019 | 4.84E-04 | 5.92E+04 | 4.99E+04 | 6781 | 0.30 | (0.09) | 0.21 |
| 58733 | 0.04 | 220 | 42.8 | 1.41 | 1.01 | 5.51 | 1.09 | 0.46 | 0.92 | 0.056 | 0.059 | 0.020 | 1.12E-03 | 1.45E+05 | -3.58E+04 | 6692 | (0.21) | (0.43) | (0.22) |
| 58730 | 0.04 | 220 | 41.35 | 2.18 | 1.32 | 6.66 | 0.8 | 0.71 | | 0.054 | 0.057 | 0.019 | 1.64E-03 | 2.05E+05 | -9.56E+04 | 6689 | (0.58) | 0.60 | (0.02) |
| 58708 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | 0.08 | 0.054 | 0.057 | 0.019 | 7.79E-05 | 9.75E+03 | 9.93E+04 | 6667 | 0.60 | (0.38) | 0.22 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.36 | 2.09 | 0.37 | 0.75 | 0.039 | 0.041 | 0.012 | 1.79E-03 | 1.51E+05 | -4.19E+04 | 6617 | (0.38) | (0.29) | 0.08 |
| 58608 | 0.04 | 220 | 29.17 | 1.08 | 0.76 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.013 | 1.62E-03 | 1.43E+05 | -3.38E+04 | 6567 | (0.29) | (0.21) | 0.09 |
| 58508 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.59 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 1.23E-03 | 1.39E+05 | -3.02E+04 | 6467 | (0.21) | (0.24) | (0.03) |
| 58308 | 0.04 | 220 | 23.85 | 0.96 | 0.66 | 5.06 | 2.65 | 0.31 | 1.40 | 0.034 | 0.036 | 0.010 | 1.81E-03 | 1.30E+05 | -2.12E+04 | 6267 | (0.24) | (1.47) | (1.23) |
| 58108 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.81 | 0.58 | 1.17 | 0.035 | 0.037 | 0.011 | 3.22E-03 | 2.42E+05 | -1.33E+05 | 6067 | (1.47) | 0.64 | 0.83 |
| 57975 | 0.04 | 220 | 21.89 | 0.58 | 0.46 | 4.08 | 2.77 | 0.19 | 0.38 | 0.031 | 0.033 | 0.009 | 8.99E-04 | 5.95E+04 | 4.96E+04 | 5934 | 0.64 | 0.81 | (0.17) |
| 57804 | 0.07 | 220 | 31.33 | 0.67 | 0.28 | 2.58 | 3.46 | 0.22 | 0.28 | 0.026 | 0.093 | 0.042 | 2.28E-04 | 2.16E+04 | 8.75E+04 | 5763 | 0.81 | 0.87 | (0.06) |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.21 | 0.028 | 0.098 | 0.046 | 1.22E-04 | 1.23E+04 | 9.68E+04 | 5578 | 0.87 | 1.03 | (0.16) |
| 57558 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.57 | 4.76 | 0.20 | 0.20 | 0.022 | 0.077 | 0.033 | 2.96E-04 | 2.27E+04 | 8.63E+04 | 5517 | 1.03 | 0.92 | 0.11 |
| 57509 | 0.07 | 220 | 33.37 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | | 0.028 | 0.098 | 0.046 | 8.77E-05 | 8.85E+03 | 1.00E+05 | 5468 | 0.92 | 0.92 | (0.01) |
| 57388 | 0.7 | 220 | 35.55 | 15.59 | 0.11 | 1.34 | 5.34 | 5.06 | 12.43 | 0.004 | 1.994 | 4.907 | 3.53E-05 | 3.79E+03 | 1.05E+05 | 5347 | 0.92 | 0.71 | 0.21 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 1.83 | 0.026 | 0.091 | 0.041 | 4.53E-04 | 4.20E+04 | 6.71E+04 | 5147 | 0.71 | 0.56 | 0.15 |
| 57058 | 0.07 | 220 | 21.69 | 1.98 | 0.49 | 4.3 | 2.86 | 0.64 | 7.72 | 0.019 | 0.068 | 0.028 | 1.11E-03 | 7.26E+04 | 3.65E+04 | 5017 | 0.56 | 0.86 | (0.30) |
| 56979 | 0.07 | 220 | 26.79 | 1.21 | 0.38 | 3.4 | 2.92 | 0.39 | 1.77 | 0.023 | 0.081 | 0.035 | 5.05E-04 | 4.09E+04 | 6.82E+04 | 4938 | 0.86 | 0.46 | 0.40 |
| 56776 | 0.07 | 220 | 23.05 | 2.2 | 0.54 | 4.47 | 2.53 | 0.71 | 0.71 | 0.020 | 0.071 | 0.030 | 1.14E-03 | 7.92E+04 | 2.99E+04 | 4735 | 0.46 | (0.63) | (0.17) |
| 56731 | 0.02 | 220 | 17.93 | 0.33 | 0.74 | 6.01 | 2.04 | | | | | 1.028 | | | | | | | |
| 56730 Wardell Bridge | | | | | | | | | | | | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.55 | 1 | 7.36 | 1.67 | 0.18 | | 0.048 | 0.011 | 0.002 | 4.36E-03 | 2.37E+05 | -1.27E+05 | 4665 | (2.54) | (2.54) | 0.00 |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.99 | 5.84 | | 0.019 | 0.067 | 0.027 | 1.16E-02 | 7.47E+05 | -6.38E+05 | 4629 | (10.80) | (10.80) | 0.00 |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.30 | | 0.022 | 0.077 | 0.033 | 3.66E-04 | 2.79E+04 | 8.12E+04 | 4584 | 1.17 | 1.17 | 0.00 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.27 | | 0.019 | 0.065 | 0.026 | 4.48E-04 | 2.82E+04 | 8.09E+04 | 4555 | 1.42 | 1.42 | 0.00 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.38 | 3.62 | 3.46 | 0.43 | | 0.019 | 0.066 | 0.027 | 7.25E-04 | 4.63E+04 | 6.28E+04 | 4533 | 1.09 | 1.09 | 0.00 |
| 56474 | 0.07 | 220 | 21.19 | 1.39 | 0.39 | 3.68 | 3.39 | 0.45 | | 0.019 | 0.066 | 0.027 | 7.53E-04 | 4.82E+04 | 6.08E+04 | 4433 | 1.08 | 1.08 | 0.00 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.06 | 2.88 | 0.58 | | 0.020 | 0.072 | 0.030 | 9.15E-04 | 6.41E+04 | 4.50E+04 | 4234 | 0.77 | 0.77 | 0.00 |
| 56200 | 0.07 | 220 | 34.8 | 0.39 | 0.2 | 2.01 | 3.55 | 0.13 | | 0.029 | 0.101 | 0.048 | 9.91E-05 | 1.04E+04 | 9.87E+04 | 4159 | 1.14 | 1.14 | 0.00 |
| 56100 | 0.07 | 220 | 27.95 | 0.67 | 0.26 | 2.6 | 3.61 | 0.22 | | 0.024 | 0.084 | 0.037 | 2.42E-04 | 2.05E+04 | 8.86E+04 | 4059 | 1.30 | 1.30 | 0.00 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.44 | | 0.017 | 0.060 | 0.023 | 8.74E-04 | 4.96E+04 | 5.95E+04 | 4033 | 1.31 | 1.31 | 0.00 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.86 | 3.98 | 0.49 | | 0.017 | 0.059 | 0.023 | 1.02E-03 | 5.67E+04 | 5.24E+04 | 4017 | 1.18 | 1.18 | 0.00 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.89 | 0.49 | | 0.021 | 0.074 | 0.031 | 7.12E-04 | 5.16E+04 | 5.75E+04 | 3959 | 1.01 | 1.01 | 0.00 |
| 55902 | 0.07 | 220 | 20.8 | 1.2 | 0.35 | 3.47 | 3.85 | 0.39 | | 0.019 | 0.065 | 0.026 | 6.88E-04 | 4.33E+04 | 6.58E+04 | 3861 | 1.37 | 1.37 | 0.00 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.48 | | 0.019 | 0.066 | 0.027 | 8.90E-04 | 5.70E+04 | 5.21E+04 | 3831 | 1.07 | 1.07 | 0.00 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.53 | | 0.019 | 0.067 | 0.027 | 9.21E-04 | 5.95E+04 | 4.95E+04 | 3759 | 1.03 | 1.03 | 0.00 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.65 | | 0.019 | 0.065 | 0.026 | 1.21E-03 | 7.57E+04 | 3.34E+04 | 3665 | 0.73 | 0.73 | 0.00 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.30 | | 0.019 | 0.067 | 0.027 | 5.08E-04 | 3.29E+04 | 7.62E+04 | 3565 | 1.66 | 1.66 | 0.00 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 1.22 | | 0.015 | 0.051 | 0.019 | 2.94E-03 | 1.40E+05 | -3.04E+04 | 3517 | (0.92) | (0.92) | 0.00 |
| 55505 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.20 | | 0.023 | 0.081 | 0.035 | 2.28E-04 | 1.84E+04 | 9.07E+04 | 3464 | 1.64 | 1.64 | 0.00 |
| 55405 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.40 | | 0.018 | 0.062 | 0.024 | 7.10E-04 | 4.17E+04 | 6.74E+04 | 3364 | 1.72 | 1.72 | 0.00 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.32 | | 0.020 | 0.072 | 0.030 | 5.05E-04 | 3.55E+04 | 7.36E+04 | 3265 | 1.62 | 1.62 | 0.00 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 0.40 | | 0.023 | 0.080 | 0.035 | 6.01E-04 | 4.81E+04 | 6.10E+04 | 3165 | 1.21 | 1.21 | 0.00 |
| 55108 | 0.07 | 220 | 17.94 | 1.78 | 0.43 | 4.16 | 4.02 | 0.58 | | 0.016 | 0.057 | 0.022 | 1.33E-03 | 7.20E+04 | 3.71E+04 | 3067 | 1.12 | 1.12 | 0.00 |
| 55005 | 0.07 | 220 | 23.25 | 1.18 | 0.36 | 3.4 | 3.48 | 0.38 | | 0.020 | 0.072 | 0.030 | 5.88E-04 | 4.13E+04 | 6.78E+04 | 2964 | 1.64 | 1.64 | 0.00 |
| 54905 | 0.07 | 220 | 22.93 | 1.34 | 0.39 | 3.6 | 3.03 | 0.44 | | 0.020 | 0.071 | 0.030 | 6.34E-04 | 4.39E+04 | 6.52E+04 | 2864 | 1.65 | 1.65 | 0.00 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.96 | 3.38 | 0.29 | | 0.022 | 0.076 | 0.033 | 3.57E-04 | 2.69E+04 | 8.22E+04 | 2764 | 1.99 | 1.99 | 0.00 |
| 54705 | 0.07 | 220 | 34.9 | 0.66 | 0.28 | 2.53 | 3.11 | 0.21 | | 0.029 | 0.102 | 0.048 | 1.94E-04 | 2.05E+04 | 8.86E+04 | 2664 | 1.59 | 1.59 | 0.00 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.75 | | 0.018 | 0.064 | 0.025 | 1.55E-03 | 9.46E+04 | 1.44E+04 | 2555 | 0.47 | 0.47 | 0.00 |
| 54511 | 0.07 | 220 | 24.21 | 2.76 | 0.63 | 4.9 | 2.78 | 0.90 | | 0.021 | 0.074 | 0.031 | 1.69E-03 | 1.24E+05 | -1.45E+04 | 2470 | (0.40) | (0.40) | 0.00 |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.45 | 2.21 | 0.10 | | 0.060 | 0.008 | 0.001 | 5.80E-03 | 3.05E+05 | -1.95E+05 | 2455 | (7.64) | (7.64) | 0.00 |
| 54440 | 0.015 | 220 | 13.78 | 0.23 | 0.77 | 6.74 | 2.56 | 0.07 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 1.95E+05 | -8.57E+04 | 2399 | (4.32) | (4.32) | 0.00 |
| 54431 | 0.015 | 220 | 12.96 | 0.23 | 0.74 | 6.7 | 2.54 | 0.07 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 1.78E+05 | -6.92E+04 | 2390 | (3.72) | (3.72) | 0.00 |
| 54430 RR Bridge | | | | | | | | | | | | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 8.23 | 2.08 | 0.12 | | 0.046 | 0.006 | 0.001 | 7.73E-03 | 3.01E+05 | -1.92E+05 | 2355 | (10.54) | (10.54) | 0.00 |
| 54305 | 0.07 | 220 | 22.04 | 20.68 | 2.26 | 11.8 | 0.94 | 6.72 | | 0.020 | 0.069 | 0.028 | 1.33E-02 | 8.87E+05 | -7.78E+05 | 2264 | (25.99) | (25.99) | 0.00 |
| 54296 | 0.07 | 220 | 24.45 | 5.68 | 1 | 6.62 | 2.57 | 1.85 | | 0.021 | 0.075 | 0.032 | 4.41E-03 | 3.26E+05 | -2.17E+05 | 2255 | (6.56) | (6.56) | 0.00 |

# Table G.6
# Summary of Pre-Construction
# Channel Slope
# Comer Debris Basin Engineering Feasibility Study

Project: Comer Basin
Task: Equilibrium Slope Calculation
1971 Grade of Calabazas Creek

Prepared by: NEN
Date Prepared: 10/09/01
K/J Proj. No.: 015014.00 G 91

**SECTION 1:**

**Upstream to Pierce Rd. #1**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 45 | 566 | to | 55 | 550 | 1000 ft | 1.6 % | 16 % |
| 55 | 550 | to | 64 | 523 | 900 ft | 3.0 % | 15 % |
| 64 | 523 | to | 84 | 479 | 2000 ft | 2.2 % | 33 % |
| 84 | 479 | to | 106 | 434 | 2200 ft | 2.0 % | 36 % |

**Total Length: 6100 ft**

**Avg. Grade: 2.2 %**

**SECTION 2:**

**Pierce Rd. #1 to Pierce Rd. #2**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 106 | 434 | to | 115 | 415 | 930 ft | 2.0 % | 100 % |

**Total Length: 930 ft**

**Avg. Grade: 2.0 %**

**SECTION 3:**

**Pierce Rd. #2 to Comer Dr.**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 115 | 415.0 | to | 138 | 379.5 | 2270 ft | 1.6 % | 62 % |
| 138 | 379.5 | to | 144 | 377.5 | 600 ft | 0.3 % | 16 % |
| 144 | 377.5 | to | 148 | 368.5 | 400 ft | 2.3 % | 11 % |
| 148 | 368.5 | to | 152 | 366.3 | 420 ft | 0.5 % | 11 % |

**Total Length: 3690 ft**

**Avg. Grade: 1.3 %**

**SECTION 4:**

**Comer Dr. to Wardell Rd.**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 152 | 366.3 | to | 158 | 353.8 | 580 ft | 2.2 % | 25 % |
| 158 | 353.8 | to | 174 | 336.0 | 1645 ft | 1.1 % | 72 % |
| 174 | 336.0 | to | 175 | 333.5 | 75 ft | 3.3 % | 3 % |

**Total Length: 2300 ft**

**Avg. Grade: 1.4 %**

**SECTION 5:**

**Wardell Rd. to SPRR**

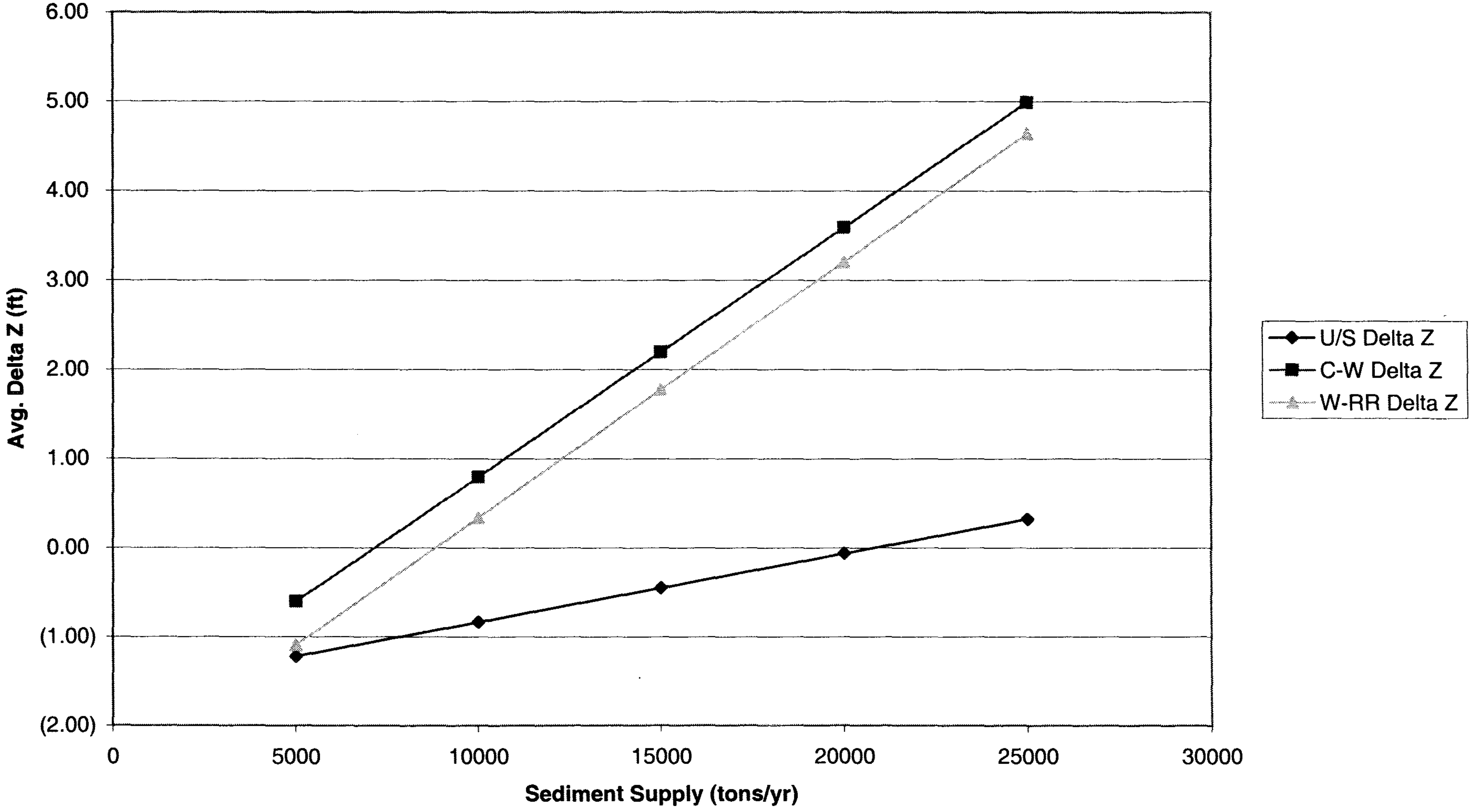
| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 175 | 333.5 | to | 197.95 | 311.5 | 2275 ft | 1.0 % | 100 % |

**Total Length: 2275 ft**

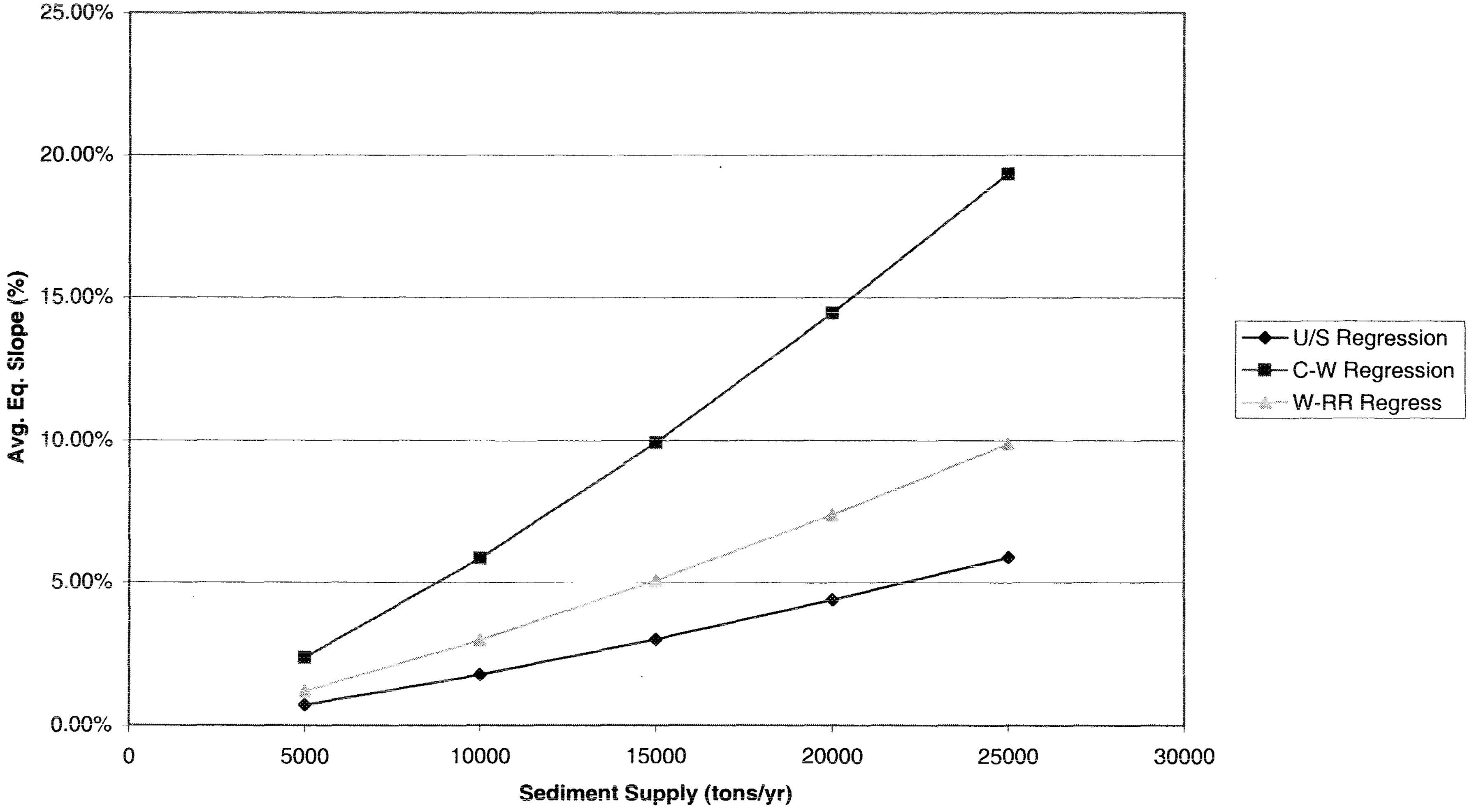
**Avg. Grade: 1.0 %**

**Total Average Grade of Calabazas Creek: 1.7 %**

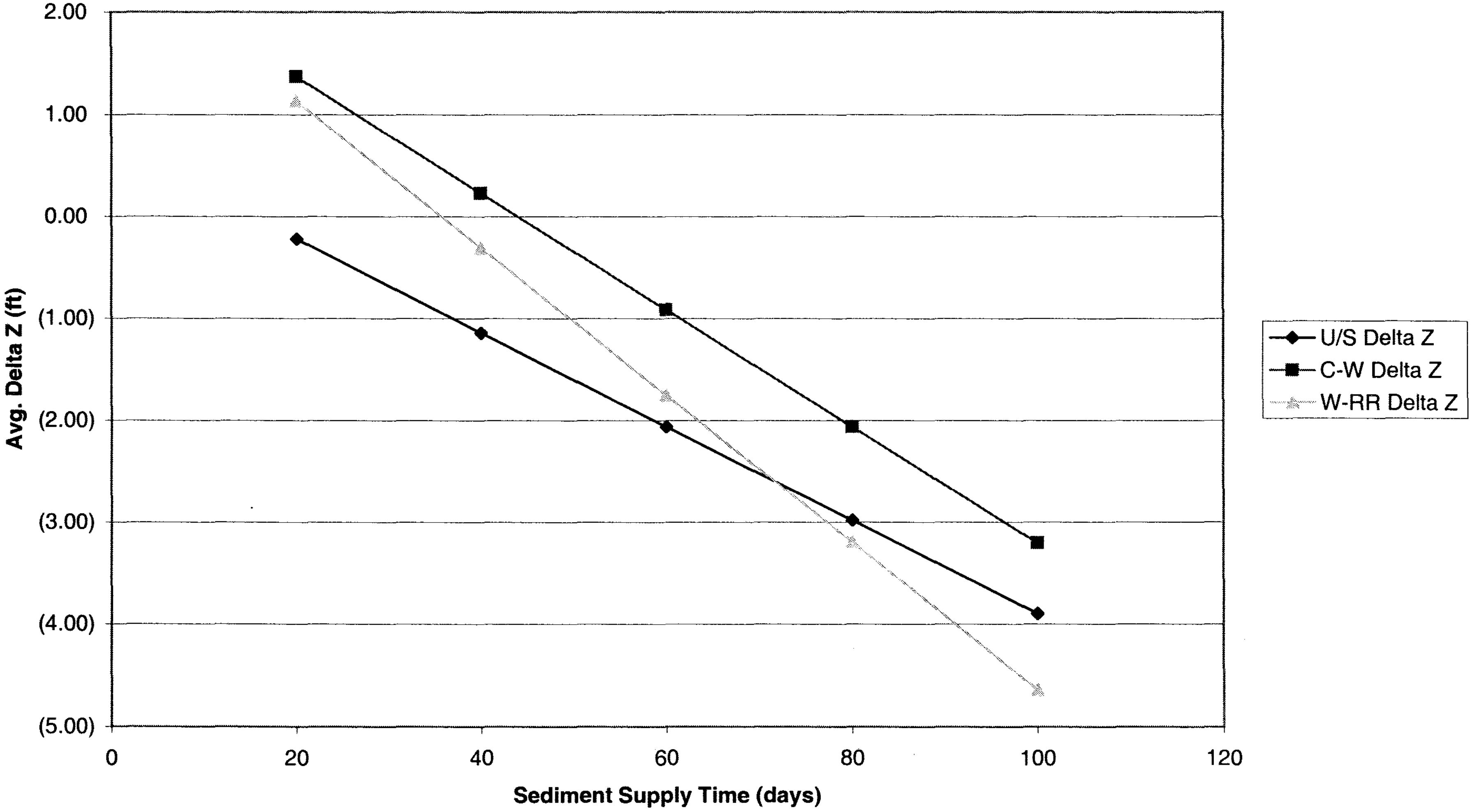
## Figure G.1
## Elevation Change Sensitivity to Sediment Supply
## (Supply Time Constant @ 35 days)



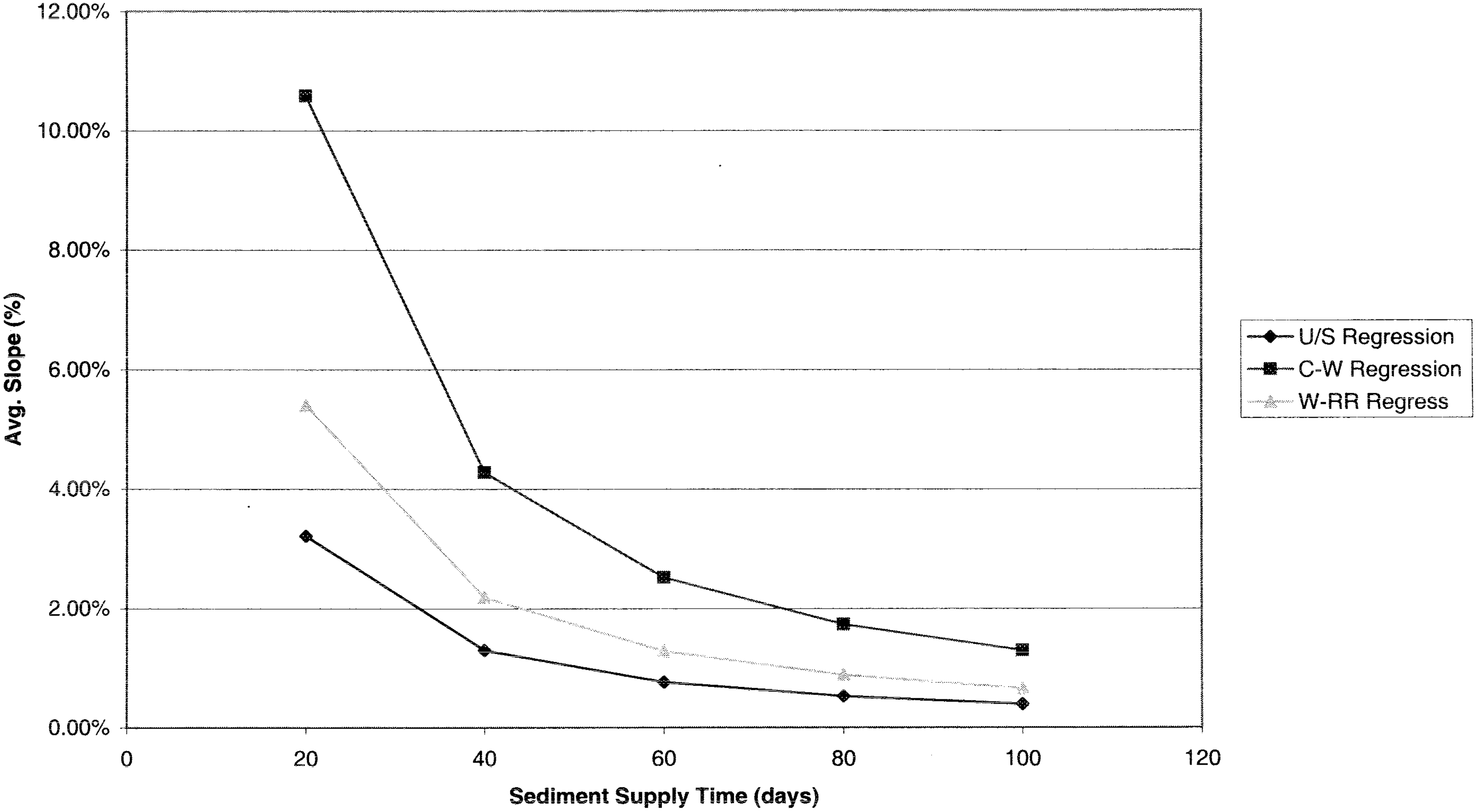
## Figure G.2
## Equilibrium Slope Sensitivity to Sediment Supply
## (Supply Time Constant @ 35 Days)



## Figure G.3
## Elevation Change Sensitivity to Time
## (Sediment Supply Constant @ 10000 tons/yr)



## Figure G.4
## Equilibrium Slope Sensitivity to Time
## (Sediment Supply Constant @ 10000 tons/yr)



U.S. Department
of Transportation

**Federal Highway
Administration**

Publication No. FHWA NHI 01-002
March 2001

Hydraulic Engineering Circular No. 20

# Stream Stability at Highway Structures

## Third Edition

NATIONAL HIGHWAY INSTITUTE
*Training Solutions for Transportation Excellence*

The dominant discharge is the flow which is of sufficient magnitude and frequency to have a dominating effect in determining the characteristics and size of the stream course, channel, and bed. It is the discharge which determines the principal dimensions and characteristics of a natural channel. The dominant formative discharge depends on the maximum and mean discharge, duration of flow, and flood frequency. For fully adjustable, perennial streams, it is normally assumed that the dominant (or channel forming) discharge is approximately equivalent to the mean annual flood peak, varying from about the 1.5-year return period peak discharge (humid regions) to the 10-year peak discharge (arid regions). When considering hydraulic geometry relationships, the dominant discharge can be taken to be the bankfull discharge, which has a return period of approximately 1.5 years in many natural channels.

The technique described above is part of Albuquerque Metropolitan Arroyo Flood Control Authority's (AMAFCA) Sediment and Erosion Design Guide(95) which establishes simplified procedures for use by public agencies and private engineers when establishing an erosion limit line, also referred to as the Prudent Line. The Prudent Line concept is based on the maximum lateral erosion distance ($\Delta_{max}$) with the primary goal of maintaining natural or naturalistic channels while protecting adjacent property through incorporation of erosion barriers, setbacks, and selective stabilization.

## 6.3 VERTICAL CHANNEL STABILITY

### 6.3.1 Overview

Vertical channel stability was introduced in Chapter 2 (Section 2.4) and in Chapter 4 (Section 4.4) through discussion of the sediment continuity concept and the Lane relationship ($QS \propto Q_s D_{50}$). In the Lane relationship, the channel is assumed to be responding to a change in discharge or sediment supply and is moving from one equilibrium geometry to another, either by a change in slope or a change in sediment size. The sediment continuity concept compares the upstream sediment supply (inflow) with the channel's ability to convey sediment (transport capacity). A difference in the inflow of sediment and the transport capacity results in either aggradation or degradation of the channel bed. While these two concepts result in a prediction of channel response in the vertical (aggradation or degradation), they do not provide a prediction of the amount of aggradation or degradation required to reach a new equilibrium state or how quickly the channel will adjust.

Chapter 3 includes a discussion of three levels of analysis: Qualitative Geomorphic Analyses (Level 1), Basic Engineering Analyses (Level 2) and Mathematical or Physical Modeling Studies (Level 3). These three levels of analysis provide the engineer with an understanding of the likely direction of vertical instability and predictions of the amounts and rates of vertical adjustment.

In Level 1 (Qualitative Geomorphic Analyses), land use change, evaluation of vertical stability and prediction of channel response are discussed. Land use change is a common cause of vertical instability as it provides the change in flow or sediment supply causing the channel response. As discussed Section 3.5.5, historic bed elevation changes can be determined by comparing channel longitudinal profiles or comparing channel cross sections. Direct evidence of channel degradation includes (1) exposed utility crossings, (2) exposed bridge foundations, (3) channel banks failing due to excessive height and (4) comparison of channel profiles and cross sections. Bridge inspection reports, which should include soundings at each bent, are a valuable tool for assessing historic channel vertical stability and can be used to predict future trends. If a historic trend is identified, extrapolation can be used to estimate future aggradation or degradation over the life of the bridge. However, if the channel is reaching a new equilibrium condition, the extrapolation will over predict future change. Conversely, if the channel is responding to more recent conditions, extrapolation of historic rates may under predict future change.

In Level 2 (Basic Engineering Analyses), watershed sediment yield, incipient motion, armoring, and rating curve shifts are introduced as factors that influence vertical stability. Changing watershed sediment yield is one factor controlling sediment supply. In coarser bed materials, the channel bed may only be mobilized for relatively high flows and an incipient motion analysis provides insight on the frequency of bed mobilization and vertical stability. When a significant portion of the bed material cannot be moved even during extreme flows, an armor layer can arrest degradation. If a USGS stream gage is located near the bridge, review of historic rating curves (stage-discharge relationships) for the gage can be used to infer vertical stability (see Section 3.6.7). If the discharge increases for a particular stage (positive shift), then the channel has probably degraded.

Level 3 (Mathematical or Physical Modeling Studies) includes sediment transport modeling. Sediment routing using computer models is the most rigorous application of the sediment continuity concept and can be used to determine single event or long-term bed elevation changes in a river.

This section includes expanded discussion on the topics of predicting aggradation and degradation. For degradation, additional discussion on incipient motion analysis and armoring is presented. Expanding on the topic of channel response, stable slope analysis is included for estimation of a new equilibrium slope after the channel has adjusted to a new sediment supply. The topic of sediment continuity is also covered in more detail than in Chapter 2. Combining sediment continuity and transport relationships results in predictive tools for degradation and aggradation rates and amounts. These concepts, which can be used directly to estimate long-term aggradation or degradation, are the basis of sediment routing models.

### 6.3.2 Degradation Analysis

Incipient Motion. Incipient motion is the condition where the hydraulic forces acting on a sediment particle are equal to the forces resisting motion. The particle is at a critical condition where a slight increase in the hydraulic forces will cause the particle to move. The hydraulic forces consist of lift and drag and are usually represented in a simplified form by the shear stress of the flow acting on the particle. Incipient motion conditions can be analyzed using the Shields diagram or by the following equation developed from the diagram:

$$D_c = \frac{\tau_o}{K_s(\gamma_s - \gamma)} \tag{6.14}$$

where:

$D_c$ = Diameter of the sediment particle at the critical condition, m (ft)
$\tau_o$ = Boundary shear stress, Pa (lb/ft$^2$)
$\gamma$ = Specific weight of water, N/m$^3$ (lb/ft$^3$)
$\gamma_s$ = Specific weight of sediment, N/m$^3$ (lb/ft$^3$)
$K_s$ = Dimensionless coefficient often referred to as the Shields parameter.

The Shields parameter can range from 0.03 to 0.10 for natural sediments based on particle shape, angularity, gradation and imbrication. The use of 0.047 for sand sizes provides reasonable results,(96,97) but lower values (0.03) are commonly used for gravel and cobble sizes.

Equation 6.14 can be used to calculate a sediment particle size that will move for a particular hydraulic condition or to calculate the shear stress required to move a particular particle size. The average shear stress acting on the channel ($\gamma RS$) includes all the factors contributing to resistance to flow (Sections 5.2.3 and 5.3.4). Only the shear stress acting on the individual particles should be used for this calculation. For sand sizes, the base value of Manning's n is representative of the grain resistance and the shear stress can be computed from:

$$\tau_o = \frac{\gamma n^2 V^2}{K_u^2 R^{(1/3)}} \tag{6.15}$$

where:

$n$ = Manning roughness coefficient
$V$ = Average channel velocity, m/s (ft/s)
$R$ = Hydraulic radius, m (ft)
$K_u$ = 1.0 SI
$K_u$ = 1.486 English

For coarser grained materials (gravel and larger) the Manning roughness coefficient is a function of grain size and flow depth. The shear stress can be computed from:

$$\tau_o = \frac{\rho V^2}{\left[5.75 \log\left(\frac{12.27 R}{k_s}\right)\right]^2} \tag{6.16}$$

where:

$\rho$ = Density of water, kg/m$^3$ (slugs/ft$^3$)
$k_s$ = Grain roughness usually taken as $3.5D_{84}$, m (ft)

Equation 6.16 is essentially Equation 6.15 with the Limerinos equation (Equation 5.11) substituted for Manning's n. In the Limerinos equation, the grain roughness is equivalent to 3.5 times $D_{84}$, although for poorly graded material grain roughness can be as low as 1.0 to 2.0 times $D_{84}$. The hydraulic depth (channel area divided by topwidth) can be substituted for hydraulic radius, R, in Equations 6.15 and 6.16 when the width-depth ratio exceeds 10.

An incipient motion example problem is solved in Appendix E.

Armoring. Armoring occurs when the hydraulic forces are sufficient to move a portion of the bed material but insufficient to move the larger sizes. Under these conditions, the smaller material is transported and removed from the bed leaving the coarse material or an armor layer. Armor layers often form in gravel bed rivers during the recession of floods. These armor layers may be disturbed during the next major flood and re-form during the flood recession. In a degrading stream with sufficient amounts of large particles, especially downstream of a dam, the large particles can form a permanent armor (pavement) which is stable under all flow conditions and arrests further degradation. The stability of an armor or pavement is relative to the armor forming discharge. If that discharge is exceeded, further degradation will occur.

The incipient motion equation can be used to determine the critical size of material that can resist a particular hydraulic condition. If at least five percent of the material is larger than the critical size ($D_{95}$ or smaller), armoring can occur. The following equation is used to predict the amount of degradation that would need to occur to form an armor layer:(98)

$$Y_s = y_a \left( \frac{1}{P_c} - 1 \right) \qquad (6.17)$$

where:

$Y_s$ = Depth of degradation or scour required to form the armor layer, m (ft)
$y_a$ = Thickness of the armor layer, m (ft)
$P_c$ = Percent of material coarser than the critical particle size expressed as a decimal fraction

Figure 6.5 illustrates armor layer development. The thickness of the armor layer ranges from one to three times the critical size ($D_c$) determined from the Shields incipient motion relation. A minimum of two times the critical size is required for a relatively stable armor layer.

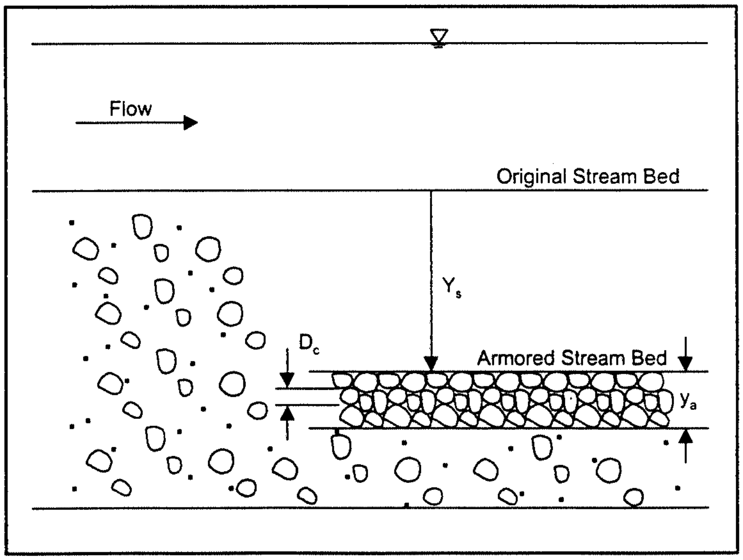


Figure 6.5. Channel armoring.

An armoring example problem is solved in Appendix E.

Equilibrium Slope Analysis. For clear-water releases of flow from dams or detention ponds, the channel immediately downstream would be expected to degrade until the reduction in slope results in a boundary shear stress too low to entrain the bed material. In a sand bed channel, the channel slope would have to be extremely low to reach incipient motion conditions and the amount of degradation could be significant. For a gravel bed channel, channel degradation would also occur, although, in addition to the reduction in slope, the formation of a pavement could arrest degradation. Depending on the bed and bank materials, the degrading channel can narrow as it deepens or the banks can become unstable and the channel can widen. Channel widening temporarily replenishes sediment supply.

For the case of no sediment supply from upstream, combining the incipient motion relation (Equation 6.14) and the Manning equation (Equation 5.3) results in an estimate of the equilibrium slope where bed material movement ceases:

$$S_{eq} = \left[ K_s D_c \left( \frac{\gamma_s - \gamma}{\gamma} \right) \right]^{(10/7)} \left( \frac{K_u}{qn} \right)^{(6/7)} \tag{6.18}$$

where:

$S_{eq}$ = Channel Slope at which particles $D_c$ will no longer move
$q$ = Channel discharge per unit width, $m^2/s$ ($ft^2/s$)
$K_s$ = Shields parameter
$K_u$ = 1.0 SI
$K_u$ = 1.486 English
$n$ = Manning roughness coefficient
$D_c$ = Critical bed material size, m (ft)

This relationship assumes that the channel width remains constant for future conditions. The critical size ($D_c$) used in this equation should be $D_{90}$ because the bed will coarsen as degradation occurs.

Another approach to determining an equilibrium slope under conditions of no upstream sediment supply is presented by the USBR using the Meyer-Peter Muller equation for beginning of transport.(98) If adjustment of the hydraulic depth due to the reduction in channel slope is included in the equation, the USBR equation is:

$$S_{eq} = K_u \frac{(D_{50})^{10/7} n^{9/7}}{(D_{90})^{5/14} q^{6/7}} \tag{6.19}$$

where:

$K_u$ = 28.0 SI
$K_u$ = 60.1 English

The degradation computed from the reduction in slope could result in channel narrowing or bank failure and channel widening. Also, the appropriate discharge for use in the equation is difficult to select. A range of discharges are responsible for forming the channel. Given long periods of time, extreme discharges would ultimately be responsible for forming the channel under these conditions. An initial estimate for the clear-water condition is to use the bankfull discharge recognizing that as the channel degrades the dimensions will adjust.

A more typical situation involves a reduction in sediment supply. In this case, the equilibrium slope can be predicted using sediment transport relationships. As shown in the Lane relationship (Chapter 4), a reduction in sediment supply or an increase in discharge can cause a reduction in channel slope and degradation. The new equilibrium slope will produce hydraulic conditions where the channel sediment transport capacity matches the upstream sediment supply. This procedure can be performed using sediment transport equations directly or through simplified relationships. Sediment transport equations are presented in detail in Highways in the River Environment(13) and are discussed later in this chapter.

It is often useful to develop a sediment transport capacity relationship for a river reach in the form of:

$$q_s = aV^bY^c \tag{6.20}$$

where:

$q_s$ = Sediment transport capacity per unit width, $m^2/s$ ($ft^2/s$)
$V$ = Channel average velocity, m/s (ft/s)
$Y$ = Channel average depth, m (ft)
$a,b,c$ = Coefficient and exponents

The coefficient and exponents can be determined from fitting Equation 6.20 to observed data or a sediment transport equation appropriate to the stream conditions. If the coefficient and exponents are fit to Yang's sediment transport equation for sand,(99) reasonable results (generally within 25 percent) are produced by the following equations. In English units the coefficients are:

$$a = 0.025\,n^{(2.39-0.8\log(D_{50}))}\,(D_{50} - 0.07)^{-1.4} \tag{6.21}$$

$$b = 4.93 - 0.74\log(D_{50}) \tag{6.22}$$

$$c = -0.46 + 0.65\log(D_{50}) \tag{6.23}$$

where:

$D_{50}$ = Mean sediment size, mm (for both SI and English applications)
$n$ = Manning's n

For metric units, b and c are unchanged, but the coefficient, a, must be multiplied by a factor of $0.3048^{(2-b-c)}$ when using Equation 6.21. **The range of data used to develop Equations 6.21 through 6.23 is shown in Table 6.1.**

| Table 6.1. Range of Parameters. | |
|---|---|
| Parameter | Value Range |
| $D_{50}$, mm | 0.1 - 2.0 |
| Velocity, m/s (ft/s) | 0.61 - 2.44 (2.0 - 8.0) |
| Depth, m (ft) | 0.61 - 7.62 (2.0 - 25) |
| Slope | 0.00005 - 0.002 |
| Manning's n | 0.015 - 0.045 |
| Froude Number | 0.07 - 0.70 |
| Unit Discharge, $m^2/s$ ($ft^2/s$) | 0.9 - 18.6 (1.0 - 200) |

For specific values of a, b, and c, the equilibrium slope can then be computed from:

$$S_{eq} = \left(\frac{a}{q_s}\right)^{\frac{10}{3(c-b)}} q^{\frac{2(2b+3c)}{3(c-b)}} \left(\frac{n}{K_u}\right)^2 \qquad (6.24)$$

where:

$S_{eq}$ = Equilibrium slope for the channel to match the upstream sediment supply
$q_s$ = Upstream sediment supply per unit width, $m^2/s$ ($ft^2/s$)
$q$ = Unit discharge, $m^2/s$ ($ft^2/s$)
$K_u$ = 1.0 SI
$K_u$ = 1.486 English

In the case of a reduction in sediment supply to a reach that was previously in equilibrium and with all other characteristics remaining constant (discharge, roughness and channel width), the equilibrium slope can be related to the existing channel slope by simplifying Equation 6.24 to produce:

$$S_{eq} = S_{ex}\left(\frac{Q_{s(future)}}{Q_{s(existing)}}\right)^{\frac{10}{3(b-c)}} \qquad (6.25)$$

where:

$S_{ex}$ = Existing channel slope
$Q_s$ = Sediment supply, $m^3/s$ ($ft^3/s$).

The sediment supply, $Q_s$, for existing conditions can be measured or computed. The sediment supply for future conditions must be computed using an applicable sediment transport relationship.(13) Equations 6.24 and 6.25 also assume that channel width and bed material size remain constant as the channel degrades. The appropriate discharge for use in these equations is the effective discharge, which is defined as the discharge responsible for the greatest amount of sediment transport and, therefore, is considered to be responsible for channel formation. If the sediment rating curve is combined with a flow duration curve, the flow that is responsible for transporting the greatest quantity of sediment is the effective discharge.

Because Equations 6.24 and 6.25 use sediment transport capacity and sediment supply where each is determined from the same sediment transport relationship, the selection of the discharge does not greatly affect the equilibrium slope prediction. The bankfull discharge can be used as a reasonable estimate when additional information is unavailable.

Base Level Control. The equilibrium slope calculations provide an estimate for the slope adjustment inferred by the Lane relationship but do not yield a prediction of the extent or amount of degradation or the amount of time required to reach equilibrium. In a sediment deficient reach, degradation occurs first at the upstream end of the reach and progresses downstream. The downstream extent of degradation is limited by some vertical control to the channel base level (Figure 6.6). The base level control could be a geologic outcrop of erosion resistant material or extremely coarse material. In a tributary channel, the confluence with a much larger river could act as a downstream control. Lakes, reservoirs or the ocean can also act as controls. Grade control structures and culverts can also limit the extent of degradation downstream. If none of these controls exist, then degradation will continue until the channel reaches the equilibrium slope along the entire profile or until armoring takes place. As tributaries contribute sediment to the downstream channel, the effects of the reduced upstream sediment supply are diminished. The amount of ultimate degradation at a location upstream of the base level control can be estimated from the equilibrium slope computation as:

$$Y_s = L(S_{ex} - S_{eq}) \tag{6.26}$$

where:

$Y_s$ = Ultimate degradation amount, m (ft)
$L$ = Distance upstream of base level control, m (ft)

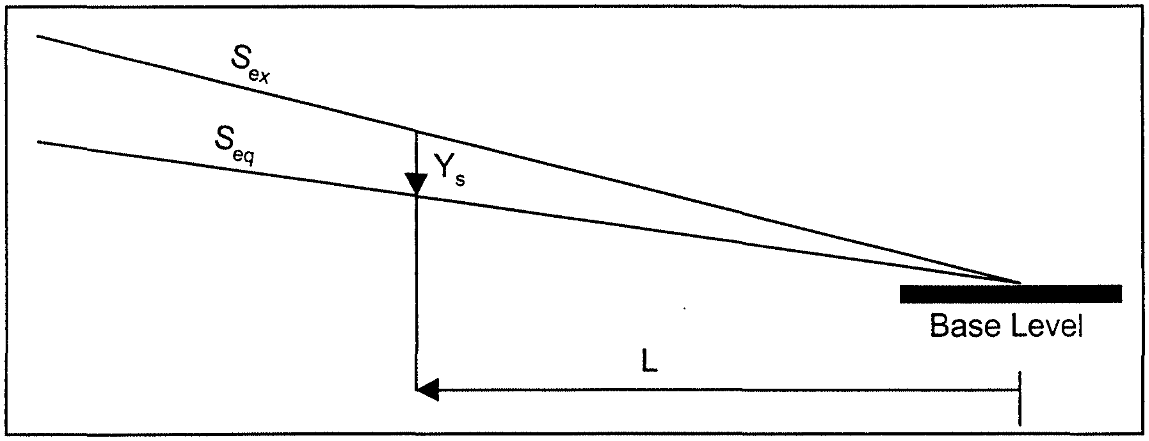


Figure 6.6. Base level control and degradation due to changes in slope.

Another consideration for base level control occurs when a control is removed or lowered on a primary channel and channel degradation progresses upstream. When a primary channel degrades, the base level control is lowered for each of its tributaries and degradation can progress up these channels. Figure 6.7 illustrates two types of upstream migrating degradation. Headcuts form in cohesive sediment and often form vertical drops with plunge pools at the base of the drop. Nickpoints form in non-cohesive sediments in which the over-steepened reach translates upstream. In each case, the cause of the degradation is a lowering of the downstream base level control. Headcuts and nickpoints are best identified though channel reconnaissance (Section 4.2) and it is reasonable to assume that the amount of degradation will be consistent over the entire stream reach.

An equilibrium slope example problem is solved in Appendix E.

### 6.3.3 Sediment Continuity Analysis

Sediment Transport Concepts. Figure 6.8 shows the various modes of sediment transport. Sediment transport formula are developed to predict bed load, suspended bed material load or bed material load based on the sediment size and hydraulic conditions. Wash load is not hydraulically controlled, but is dependent on the supply of fine material from watershed and bank erosion. At high wash load concentrations the transport capacity of the bed material load can increase significantly. Highways in the River Environment(13) includes an in-depth discussion of sediment transport processes, equations for predicting sediment transport and recommendations on the selection of an appropriate equation. This section will focus on two relatively easy to use bed material load equations that can be used in a sediment continuity analysis: Yang's equations for sand and gravel.(99) The sand equation is:

$$\log C_t = 5.435 - 0.286\log\frac{\omega D_{50}}{\nu} - 0.457\log\frac{U.}{\omega} + \left(1.799 - 0.409\log\frac{\omega D_{50}}{\nu} - 0.314\log\frac{U.}{\omega}\right)\log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right) \quad (6.27)$$

and for gravel:

$$\log C_t = 6.681 - 0.633\log\frac{\omega D_{50}}{\nu} - 4.816\log\frac{U.}{\omega} + \left(2.784 - 0.350\log\frac{\omega D_{50}}{\nu} - 0.282\log\frac{U.}{\omega}\right)\log\left(\frac{VS}{\omega} - \frac{V_{cr}S}{\omega}\right) \quad (6.28)$$

where:

$C_t$ = Sediment concentration in parts per million by weight
$\omega$ = Fall velocity of the sediment, m/s (ft/s)
$\nu$ = Kinematic viscosity, $m^2/s$ ($ft^2/s$)
$U.$ = Shear velocity $\left(\sqrt{gRS}\right)$, m/s (ft/s)
$V$ = Velocity, m/s (ft/s)
$V_{cr}$ = Critical Velocity, m/s (ft/s)
$S$ = Energy slope

In the above equations, the dimensionless critical velocity is given by:

$$\frac{V_{cr}}{\omega} = \frac{2.5}{\log\frac{U.\,D_{50}}{\nu} - 0.06} + 0.66 \text{ for } 1.2 < \frac{U.\,D_{50}}{\nu} < 70 \qquad (6.29)$$

and

$$\frac{V_{cr}}{\omega} = 2.05 \text{ for } \frac{U_* D_{50}}{\nu} \geq 70 \qquad (6.30)$$

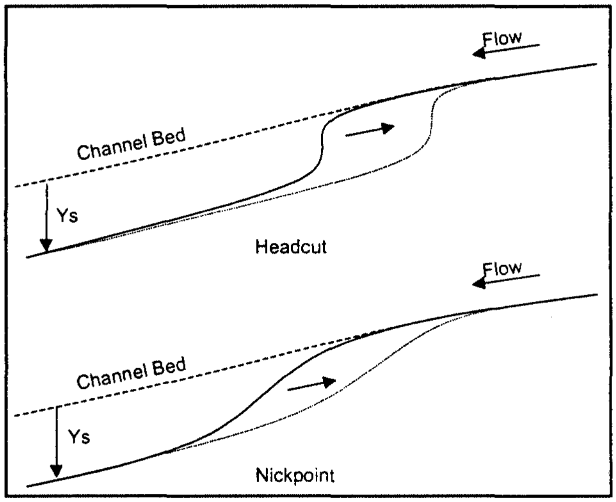


Figure 6.7. Headcuts and Nickpoints.

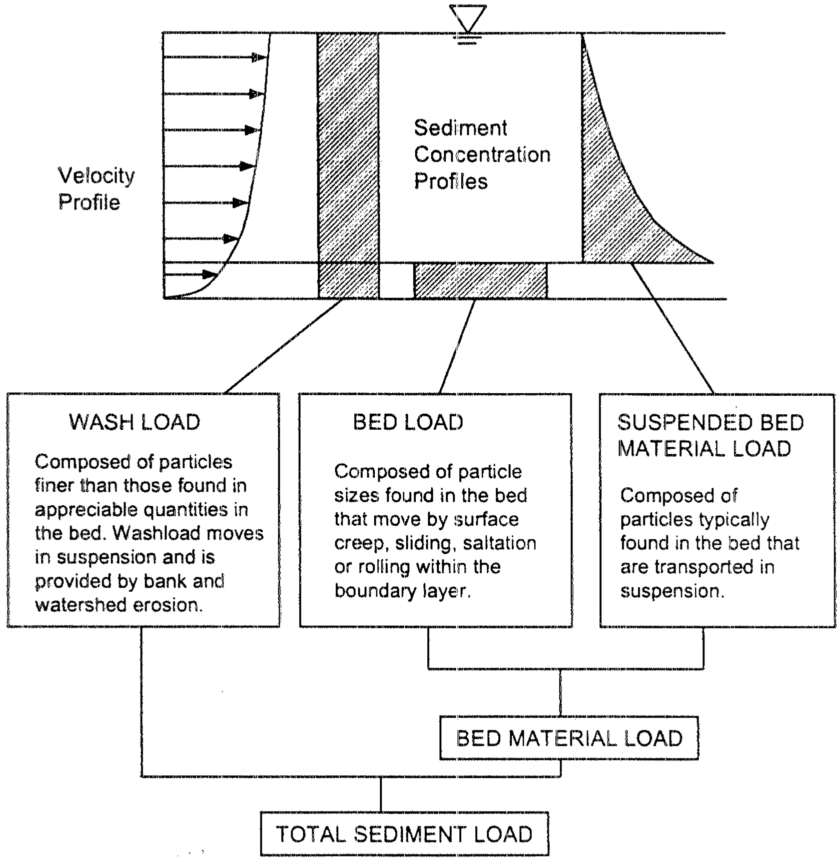
The sediment discharge per unit channel width is:

$$q_s = \frac{qC_t}{\frac{\gamma_s}{\gamma} x 10^6} \qquad (6.31)$$

where: $q_s$ is in $m^2/s$ ($ft^2/s$).

Based on these or other sediment transport relationships, the sediment transport capacity of individual river cross sections in a channel reach can be predicted. The sediment transport can then be used to compute volumes of material being transported and, by comparing with sediment supply to a reach, aggradation and degradation rates can be predicted. For specific site conditions, simplified relationships in the form of Equation 6.20 can be fit to the results of the more rigorous sediment transport equations (such as 6.27 and 6.28) and estimates of equilibrium slope can be made.

Sediment Continuity Analysis for Aggradation or Degradation. The transport rates can be determined for a range of discharges and combined with a flow duration curve to determine the effective channel discharge. The sediment transport rates can also be summed for a specific flood hydrograph to predict single event aggradation or degradation. In order to do this the sediment supply and the reach transport capacity must be computed. As shown in Figure 2.12, the difference between sediment inflow and outflow results in either bed aggradation or degradation. The volume of material either eroded or deposited is:



Composed of particles finer than those found in appreciable quantities in the bed. Washload moves in suspension and is provided by bank and watershed erosion.

Composed of particle sizes found in the bed that move by surface creep, sliding, saltation or rolling within the boundary layer.

Composed of particles typically found in the bed that are transported in suspension.

Figure 6.8. Definition of sediment load components.

$$\Delta V = V_{s(\text{inflow})} - V_{s(\text{outflow})} \tag{6.32}$$

where:

$\Delta V$ = Volume of sediment stored or eroded, $m^3$ ($ft^3$)
$V_{s(\text{inflow})}$ = Volume of sediment supplied to a reach, $m^3$ ($ft^3$)
$V_{s(\text{outflow})}$ = Volume of sediment transport out of a reach, $m^3$ ($ft^3$)

The inflowing and outflowing sediment volumes are equal to:

$$V_s = q_s W \Delta t \tag{6.33}$$

where:

$W$ = Channel width, m (ft)
$\Delta t$ = Time increment, s
$q_s$ = Unit sediment discharge, $m^2/s$ ($ft^2/s$)

Equation 6.33 can be summed over a hydrograph to determine sediment volumes during a flood event or can be combined with a flow duration curve to predict long-term rates. The amount of aggradation or degradation is then computed with:

$$\Delta Z = \frac{\Delta V}{WL(1-\eta)} \tag{6.34}$$

where:

$\Delta Z$ = Change in bed elevation, m (ft)
$\eta$ = Porosity of the bed material (volume of the voids/total volume of a sample)
L = Reach length, m (ft)

Because channel aggradation or degradation are adjustments towards a new equilibrium condition, the hydraulic model should be adjusted by the amounts computed in Equation 6.34 before a new flood hydrograph is analyzed. Also, the stability of the new bank heights should be assessed to determine whether channel widening will occur.

A sediment continuity analysis example is solved in Appendix E.

Sediment Transport Modeling. The sediment continuity analysis described above can be complex and labor intensive. Sediment transport models use the above procedures to route sediment down a channel and adjust the channel geometry to reflect imbalances in sediment supply and transport capacity. The BRI-STARS(23) and HEC-6(24) models are examples of sediment transport models that can be used for single event or long-term degradation estimates. The information needed to run these models includes:

1. Channel and floodplain geometry
2. Structure geometry
3. Roughness
4. Geologic or structural vertical controls
5. Downstream water surface relationship
6. Event or long term inflow hydrographs
7. Tributary inflow hydrographs
8. Bed material gradations
9. Upstream sediment supply
10. Tributary sediment supply
11. Selection of appropriate sediment transport relationship
12. Depth of alluvium

These models perform hydraulic and sediment transport computations on a cross section basis and adjust the channel geometry prior to proceeding with the next time step. Because the actual flow hydrograph is input, the simplifying assumption of using an effective discharge is avoided. BRI-STARS(23) also has an option where width adjustment can be predicted.

By MHM Date 11/9/01 Subject SAMPLE CALCS : HEC-20 Job No. 015014.00
Checked By ______ Date ______ Sheet 1 of 10

USE FHWA HEC-20, 3RD Ed. (Ref 1) to estimate potential for erosion or sedimentation

A) SEDIMENT CHARACTERISTICS

1) No Sieve Analysis data available

2) Use curve considered representative of bed sediment.

Source: Table E.5, Ref. 1.

Provided as Attachment 1

$D_{90}$ = 250 mm = 0.82 ft

$D_{50}$ = 110 mm = 0.36 ft

B) Use Flow from 2.5 yr storm event

DISTRICT PROVIDED Q = 220 cfs

---

Ref. 1: Stream Stability at Highway Structures, 3RD Ed., 3/2001. FHWA Report No.: FHWA NHI 01-002/HEC-20

By MHM Date 11/9/01 Subject HEC-20 Job No. 0150/4.00
Checked By ________ Date ________ Sheet 2 of 10

C) DEGRADATION ANALYSIS

1) Approach follows Ch. 6, Ref. 1:

a) Incipient Motion
b) Potential for armoring
c) Equilibrium Slope Analysis
d) Base Level Control → Est. of El. Change.

2) SAMPLE CALCS FOR EXISTING CONDITIONS FOR CHANNEL CROSS-SECTION STATION

59096, which is 96' u/s of Comet Drive

HEC-RAS results from Table E.2, supplied as Attachment 2.

3) Incipient Motion

a) HEC-RAS: AVG. BED SHEAR: 0.24 lb/ft$^2$

b) Use Eq. 6.14, Ref. 1

$$D_c = \frac{\tau_o}{K_s(\gamma_s - \gamma)}$$

where $D_c$ = largest particle dia @ critical condition (ft)
$\tau_o$ = Boundary shear stress (lb/ft$^2$)
$K_s$ = Shields parameter : 0.03 for coarse sediment (Ref 1)
$\gamma$ = UNIT WEIGHT $H_2O$
$\gamma_s$ = UNIT WEIGHT SEDIMENT

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c) Input Values

$\tau_0 = 0.24$ lb/ft² ⇒ HEC RAS

$\gamma = 62.4$ lb/ft³

$\gamma_s = 165$ lb/ft³

$K_s = 0.03$ (Ref. 1, p. 6.15)

$$D_c = \frac{0.24}{(0.03)(165-62.4)} \text{ ft}$$

$= 0.08$ ft ≈ 24.8 mm

= Max particle diameter subject to motion for flow conditions @ Station.

4) ARMORING POTENTIAL

a) FROM ATTACHMENT 1,

$D_c \approx D_{25} < D_{95}$ ∴ ARMORING MAY OCCUR

b) FOR ARMOR LAYER THICKNESS = $3D_c$ (Ref. 1, p.6.16)

$y_a = 3(0.08) = 0.24$ ft

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c) Use Eq. 6.17, Ref 1

$$y_s = y_a\left(\frac{1}{P_c} - 1\right)$$

i) $P_c = 0.75$ = percentage of particle distribution coarser than $D_c$

ii) $$y_s = 0.24\left(\frac{1}{0.75} - 1\right)$$

= 0.08 ft

= depth to ARMOR LAYER

∴ ARMORING AT THIS STATION IS PROBABLE.

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Checked By ____ Date ____ Sheet 5 of 10

5) EQUILIBRIUM SLOPE ANALYSIS

a) CASE 1: No Sediment Supply from Upstream

i) Use Shields Equation: (Ref 1, Eq. 6.18)

$$S_{eq} = \left[ K_s D_c \left[ \frac{\gamma_s - \gamma}{\gamma} \right] \right]^{10/7} \left( \frac{K_n}{q n} \right)^{(6/7)}$$

where $S_{eq}$ = Channel Slope at which $D_c$ no longer move (ft/ft)

$q$ = unit discharge (ft²/s)

$K_s$ = Shields Parameter (0.03)

$K_n$ = 1.486

$n$ = Manning's "n"

$D_c$ = CRITICAL BED SIZE (ft)

Use $D_{90}$ per Ref 1 for $D_c$

$$S_{eq} = \left[ (0.03)(0.82) \left( \frac{155 - 62.4}{62.4} \right) \right]^{10/7} \cdot \left\{ \frac{(1.486)}{\left( \frac{220}{\underset{\uparrow}{39.98}} \right)(0.04)} \right\}^{6/7}$$

TOP WIDTH CHANNEL

$$= 0.053 \text{ ft/ft}$$

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ii) Use Meyer-Peter/Muller Eqn (Ref. 1, Eq. 6.19)

$$S_{eq} = (K_u)_m \frac{(D_{50})^{10/7} n^{9/7}}{(D_{90})^{5/14} q^{6/7}}$$

where $(K_u)_m$ = 66.1 for Meyer-Peter/Muller

$$S_{eq} = (60.1)\frac{(0.36)^{10/7}(0.04)^{9/7}}{(0.82)^{5/14}\left(\frac{220}{39.98}\right)^{6/7}} = 0.055 \text{ ft/ft}$$

b) CASE 2: SEDIMENT SUPPLY: REGRESSION EQN.

$$S_{eq} = \left(\frac{a}{q_s}\right)^{\frac{10}{3(c-b)}} q^{\frac{2(2b+3c)}{3(c-b)}} \left(\frac{n}{K_u}\right)^2$$ (Eq. 6.24 Ref. 1)

Where

$S_{eq}$ = Eq. slope for channel to match u/s sed supply (ft/ft)

$q_s$ = u/s sed supply per unit width (ft²/s)

$q$ = unit discharge (ft²/s)

$K_u$ = 1.486

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i) COEFFICIENTS

REGRESSION EQN BASED ON COEFFICIENTS

$$a = 0.025\, n^{(2.34 - 0.8 \mathrm{LOG}(D_{50}))} \cdot (D_{50} - 0.07)^{-1.4}$$ (Ref. 1 Eq. 6.21)

$$b = 4.93 - 0.74\, \mathrm{LOG}(D_{50})$$ (Eq. 6.22, Ref 1)

$$c = -0.46 + 0.65\, \mathrm{LOG}(D_{50})$$ (Eq. 6.23, Ref 1)

$D_{50}$ is used in mm

$$a = 0.025(0.04)^{(2.39 - 0.8 \mathrm{LOG}(110))} \cdot (110 - 0.07)^{-1.4}$$

$$= 3.04(10)^{-6}$$

$$b = 4.93 - 0.74 \mathrm{LOG}(110) = 3.42$$

$$c = -0.46 + 0.65 \mathrm{LOG}(110) = 0.87$$

By MLFM Date 11/9/01 Subject HEC-20 Job No. 0150140.00

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ii) SED Supply estimate

$Q_s = 0.036$ cfs (see ATTACHMENT 2)

$$S_{eq} = \left[\frac{3.04(10)^{-6}}{\left(\frac{0.036}{39.98}\right)}\right]^{\frac{10}{3(0.87-3.42)}} \cdot \frac{220}{39.98}^{\frac{2(2(3.42)+3(0.87))}{3(0.87-3.42)}} \cdot \left(\frac{0.04}{1.486}\right)^2$$

$= 0.018$ ft/ft

6) BASE LEVEL CONTROL

a) EVALUATE SEDIMENT TRANSPORT CAPACITY FOR SECTION

Use

$$q_s = aV^bY^c \qquad \text{(Ref. 1, Eq. 6.20)}$$

Where $q_s$ = Sed transport capacity per unit width ($ft^2/s$)

$V$ = Avg. Channel Velocity ft/s

$Y$ = Avg. Channel depth ft

* N.B. IN ABSENCE OF ESTIMATE OF TSS CONCENTRATION BY USER, EQ 6.20 IS USED RATHER THAN 6.31

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$q_s = 3.04(10)^{-5} \cdot (2.59)^{3.42} \cdot (2.83)^{0.3}$

→ [illegible] : See ATTACHMENT 2

$= 1.95(10)^{-4}\ ft^2/s$

b) ELEVATION CHANGE

$$\Delta Z = \frac{\Delta V}{WL(1-n)}$$ (Ref: [illegible] Eq. 6.34)

Where $\Delta Z$ = Change in Bed Elevation

$n$ = porosity of Bed Mat'l (assumed to be 0.4)

$W$ = Channel width

$L$ = Distance to fixed elevation loc'n (ASSUMED TO BE [illegible] ROAD BRIDGE 500 ft)

i) $\Delta V$ = Vol Sed in − Vol Sed out

→ 9000 tons/35 days $= 1.09(10)^5\ ft^3$ (see ATTACHMENT 2)

(1) $V_s = q_s W \Delta t$

→ est. @ 35 days $= 3.02(10)^6$ sec

→ HZ RAS: 39.98 ft

$$= (1.95(10)^{-4})(39.98)(3.02(10)^6) = \underline{\underline{2.35(10)^4\ ft^3}}$$

By____ Date 11/9/01 Subject HEC-20 Job No. 015014.00

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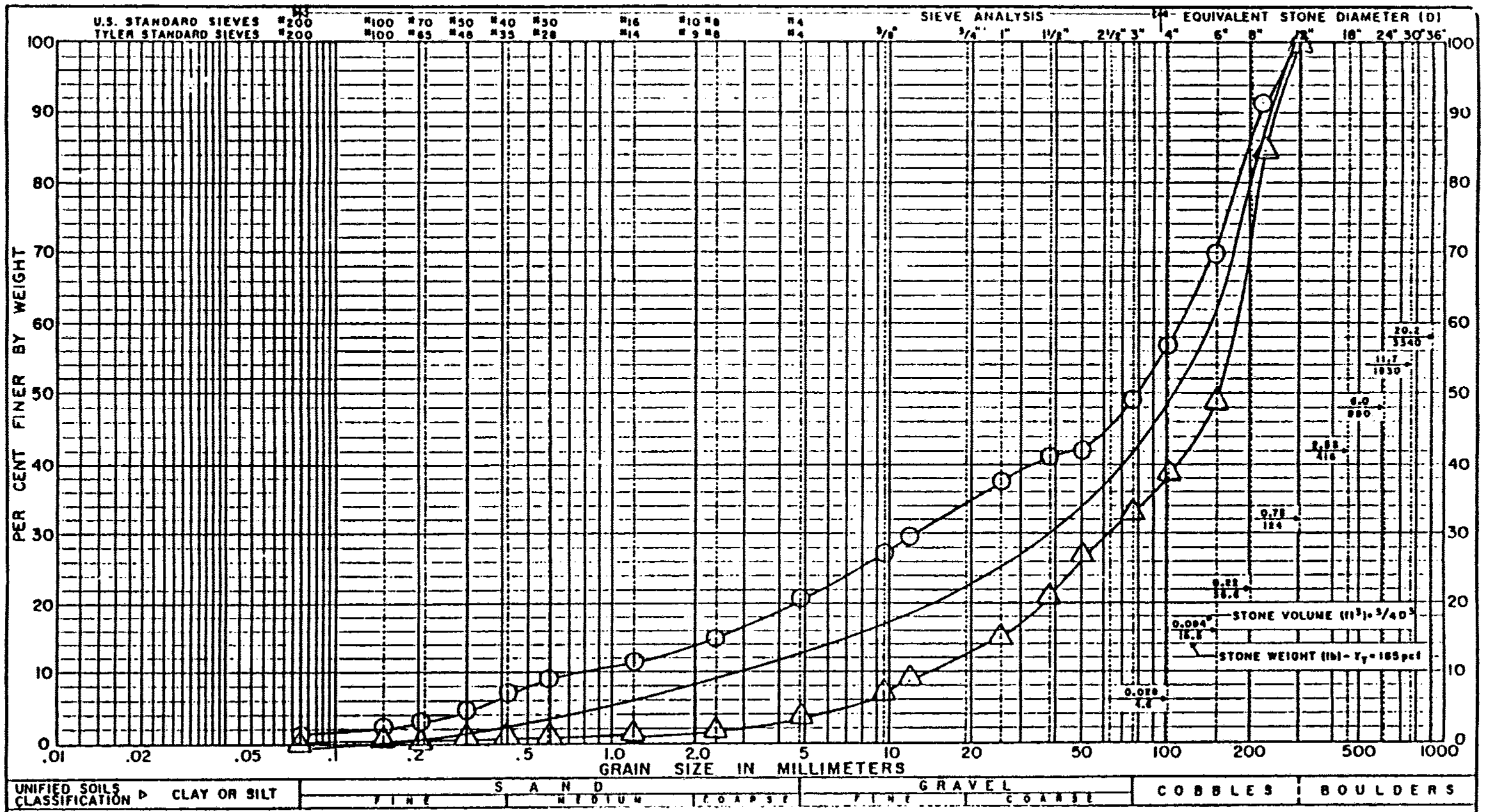
$$(2)\quad \Delta V = 1.09(10)^5 - 2.35(10)^4 \ \text{ft}^3$$

$$= 8.55(10)^4 \ \text{ft}^3$$

$$ii)\quad \Delta Z = \frac{8.55(10)^4}{(39.98)(7055)(1-0.4)} = \underline{\underline{0.51}} \ \text{ft}$$

↳ DISTANCE FROM STA. 59096 TO PROSPECT ROAD

RESULT IS ESTIMATE THAT THERE WILL BE ACCUMULATION OF 0.51 FEET OF SEDIMENT @ STATION 59096.



| SYMBOL | LOCATION | DESCRIPTION OF SAMPLE |
|---|---|---|
| ⊙ | UPSTREAM SITE | DARK BROWN COBBLES, SOME GRAVEL, SOME COARSE TO FINE SAND |
| △ | DOWNSTREAM SITE | DARK GRAY COBBLES, SOME GRAVEL, TRACE SAND |

PLATE NO.

GRADATION CURVES
RIVER GRAVEL AND SAND

PLATE NO

Figure E.1. Bed material size gradation curves.

Attachment 1
(Ref. 1)
Sample Calcs

SAMPLE CALCS
ATTACHMENT 2

# Table E.2
## Existing Conditions
## Sediment Analysis Summary

Input Values

| Factors | |
|---|---|
| Ks | 0.05 |
| Kd | 1.406 |
| K(mpm) | 60.1 |
| Unit Weight H2O (pcf) | 62.4 |
| Unit Weight SED (pcf) | 165 |
| D90 (mm) | 250 |
| D90 (ft) | 0.820 |
| D50 (mm) | 190.0 |
| D50 (ft) | 0.291 |

Exponents
a 3.036E-06
b 3.419
c 0.667

Upstream Sediment Supply
Based on estimate of sed supply from USGS 1978 Report

Est. total [illegible] tons
Sed Loading Period 35 days
Time Δt 3024000 sec

Assume Majority of Sed Load from 3 or 4 Major Storms in Water Year

Sed Volume 1.09E+05 cu. ft.

$Q_s$ 0.036 cfs

Prospect Rd Sta 52041

Assume Sediment Porosity 0.4

2.3 YR RAS Input Data

| River Sta | Mann Wtd Chnl | Q Channel (cfs) | 2.3 Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3Yr Max Chl Dpth (ft) | Incipient Motion (ft) | Comer to Wardell Depth to Armor (ft) | Eq Slope Shields (No Sed Supply) (ft/ft) | Eq Slope (MP-M) (No Sed Supply) (ft/ft) | Eq Slope (Regression) (Sed Supply) (ft/ft) | Transport Capacity $q_s = aV^bY^c$ ($ft^2/s$) | Sediment Outflow $q_sW\Delta t$ ($ft^3$) | Net Change ΔV= Supply - Outflow ($ft^3$) | Distance to Prospect Rd. (ft) | ExCond Base El. Change ΔZ (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69696 | 0.04 | 220 | 9.30 | 3.09 | 1.01 | 9.15 | 3.50 | 1.00 | | 0.015 | 0.016 | 0.003 | 1.78E-02 | 5.08E+05 | -3.97E+05 | 17653 | (3.98) |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.10 | 6.12 | 2.19 | 0.85 | | 0.026 | 0.028 | 0.007 | 7.72E-03 | 4.13E+05 | -3.04E+05 | 17453 | (1.64) |
| 69196 | 0.04 | 220 | 30.07 | 1.16 | 0.82 | 5.34 | 2.01 | 0.36 | | 0.042 | 0.045 | 0.014 | 1.71E-03 | 1.80E+05 | -6.06E+04 | 17153 | (0.16) |
| 68896 | 0.04 | 220 | 25.66 | 1.51 | 0.94 | 6 | 1.54 | 0.49 | | 0.040 | 0.042 | 0.012 | 2.02E-03 | 1.75E+05 | -6.62E+04 | 16853 | (0.27) |
| 68396 | 0.04 | 220 | 21.84 | 1.81 | 1 | 6.88 | 3.16 | 0.62 | | 0.031 | 0.033 | 0.009 | 6.08E-03 | 4.00E+05 | -2.91E+05 | 16353 | (1.38) |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.30 | 10.06 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.006 | 1.64E-02 | 6.68E+05 | -6.59E+05 | 15753 | (4.38) |
| 67396 | 0.04 | 220 | 27.93 | 1.26 | 0.63 | 5.61 | 2.06 | 0.42 | | 0.039 | 0.041 | 0.012 | 2.06E-03 | 1.76E+05 | -6.70E+04 | 15353 | (0.20) |
| 66896 | 0.04 | 220 | 20.36 | 1.69 | 1.01 | 6.29 | 2.14 | 0.56 | | 0.040 | 0.043 | 0.013 | 3.14E-03 | 2.79E+05 | -1.70E+05 | 14853 | (0.64) |
| 66866 | 0.04 | 220 | 17.67 | 0.83 | 0.53 | 4.63 | 2.75 | 0.27 | | 0.029 | 0.028 | 0.007 | 1.88E-03 | 8.80E+04 | 2.31E+04 | 14824 | 0.15 |
| 66850 | 0.04 | 220 | 24.87 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.011 | 8.14E-04 | 6.15E+04 | 4.78E+04 | 14800 | 0.21 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.010 | 2.98E-03 | 2.14E+05 | -1.06E+05 | 14753 | (0.50) |
| 66396 | 0.04 | 220 | 21.6 | 2.06 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.009 | 5.10E-03 | 3.33E+05 | -2.24E+05 | 14353 | (1.20) |
| 66246 | 0.04 | 220 | 23.52 | 0.87 | 0.63 | 4.6 | 3.56 | 0.28 | | 0.039 | 0.038 | 0.011 | 1.86E-03 | 1.51E+05 | -4.24E+04 | 14206 | (0.19) |
| 66245 | Vista Regina Bridge | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.96 | 1.01 | 6.99 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.009 | 5.71E-03 | 3.95E+05 | -2.86E+05 | 14175 | (1.42) |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.61 | 1.09 | | 0.036 | 0.040 | 0.012 | 7.65E-03 | 6.33E+05 | -5.24E+05 | 14056 | (2.27) |
| 65796 | 0.04 | 220 | 20.44 | 1.75 | 1 | 6.46 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.011 | 2.70E-03 | 2.16E+05 | -1.07E+05 | 13755 | (0.48) |
| 65196 | 0.04 | 220 | 34.85 | 0.86 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.016 | 9.04E-04 | 9.52E+04 | 1.38E+04 | 13155 | 0.05 |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.86 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.004 | 1.06E-02 | 4.92E+05 | -3.83E+05 | 12555 | (3.15) |
| 63996 | 0.04 | 220 | 17.45 | 1.65 | 0.91 | 6.97 | 2.89 | 0.60 | | 0.026 | 0.027 | 0.007 | 5.47E-03 | 2.89E+05 | -1.80E+05 | 11955 | (1.44) |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.028 | 0.028 | 0.007 | 6.89E-03 | 3.68E+05 | -2.59E+05 | 11655 | (2.10) |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.67 | 0.19 | | 0.032 | 0.034 | 0.009 | 9.67E-04 | 6.61E+04 | 4.29E+04 | 11579 | 0.27 |
| 63596 | 0.04 | 220 | 26.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.013 | 3.90E-04 | 3.44E+04 | 7.47E+04 | 11555 | 0.37 |
| 63396 | 0.04 | 220 | 12.45 | 2.56 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.006 | 1.06E-02 | 3.99E+05 | -2.90E+05 | 11355 | (3.42) |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.06 | 2.48 | 0.85 | | 0.029 | 0.026 | 0.007 | 8.36E-03 | 4.45E+05 | -3.36E+05 | 10755 | (2.96) |
| 62680 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.008 | 2.74E-03 | 1.62E+05 | -5.32E+04 | 10640 | (0.43) |
| 62670 | Pierce Bridge | | | | | | | | Pierce Bridge | | | | | | | | |
| 62662 | 0.04 | 220 | 19.96 | 2.1 | 1.01 | 7.13 | 2 | 0.68 | | 0.029 | 0.031 | 0.008 | 4.57E-03 | 2.76E+05 | -1.67E+05 | 10621 | (1.31) |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.83 | 10.37 | 2.02 | 1.58 | | 0.031 | 0.032 | 0.009 | 1.86E-02 | 1.07E+06 | -9.60E+05 | 10590 | (7.10) |
| 62596 | 0.04 | 220 | 29.36 | 1.89 | 1.09 | 6.62 | 2.06 | 0.65 | | 0.037 | 0.039 | 0.011 | 4.01E-03 | 3.20E+05 | -2.11E+05 | 10555 | (1.26) |
| 62096 | 0.04 | 220 | 47.40 | 0.76 | 0.7 | 4.17 | 1.98 | 0.25 | | 0.061 | 0.064 | 0.022 | 7.24E-04 | 1.04E+05 | 5.09E+03 | 10055 | 0.02 |
| 61896 | 0.04 | 220 | 25.73 | 1.45 | 0.88 | 5.97 | 2.3 | 0.47 | | 0.036 | 0.039 | 0.011 | 2.81E-03 | 2.19E+05 | -1.10E+05 | 9855 | (0.74) |
| 61396 | 0.04 | 220 | 21.9 | 1.06 | 0.80 | 5.34 | 2.67 | 0.34 | | 0.031 | 0.033 | 0.009 | 2.19E-03 | 1.45E+05 | -3.57E+04 | 9355 | (0.29) |
| 60896 | 0.04 | 220 | 21.85 | 1.91 | 1 | 6.67 | 2.96 | 0.62 | | 0.031 | 0.033 | 0.009 | 5.64E-03 | 3.73E+05 | -2.64E+05 | 8855 | (2.27) |
| 60396 | 0.04 | 220 | 39.21 | 0.29 | 0.33 | 2.69 | 3.03 | 0.08 | | 0.062 | 0.065 | 0.018 | 2.34E-04 | 2.77E+04 | 8.13E+04 | 8355 | 0.41 |
| 59796 | 0.04 | 220 | 30.94 | 1.29 | 0.83 | 5.35 | 2.08 | 0.42 | | 0.063 | 0.066 | 0.016 | 1.77E-03 | 2.14E+05 | -1.06E+05 | 7755 | (0.54) |
| 59500 | 0.04 | 220 | 25.34 | 1.79 | 1 | 6.59 | 1.73 | 0.58 | | 0.036 | 0.038 | 0.011 | 3.03E-03 | 2.32E+05 | -1.23E+05 | 7459 | (1.09) |
| 59396 | 0.04 | 220 | 65.54 | 0.05 | 0.14 | 1.28 | 3.69 | 0.02 | | 0.085 | 0.089 | 0.035 | 2.17E-06 | 4.57E+03 | 1.05E+05 | 7355 | 0.34 |
| 59300 | 0.04 | 220 | 43.32 | 0.44 | 0.47 | 3.32 | 2.57 | 0.14 | | 0.058 | 0.060 | 0.020 | 4.17E-04 | 5.48E+04 | 5.45E+04 | 7259 | 0.29 |
| 59100 | 0.04 | 220 | 36.11 | 1.53 | 1.02 | 5.78 | 2.06 | 0.50 | | 0.050 | 0.053 | 0.017 | 2.29E-03 | 2.64E+05 | -1.56E+05 | 7059 | (0.98) |
| → 59096 | 0.04 | 220 | 39.96 | 0.24 | 0.31 | 2.59 | 2.63 | 0.06 | | 0.063 | 0.066 | 0.018 | 1.94E-04 | 2.34E+04 | 8.57E+04 | 7055 | 0.51 ← |
| 59036 | 0.04 | 220 | 31.84 | 0.53 | 0.48 | 3.74 | 2.62 | 0.17 | | 0.043 | 0.046 | 0.014 | 6.78E-04 | 6.53E+04 | 4.38E+04 | 6995 | 0.33 |
| Average | | | 34.12 | 1.35 | 0.79 | 5.20 | 2.47 | | | 0.044 | 0.048 | 0.015 | | | | | (0.91) |
| | | | | | | | | | | | | | | | | | |
| 59035 | Comer Bridge | | | | | | | | Comer Bridge | | | | | | | | |
| 59000 | 0.04 | 220 | 31.11 | 0.9 | 0.68 | 4.7 | 2.31 | 0.29 | 0.58 | 0.042 | 0.045 | 0.014 | 1.25E-03 | 1.17E+05 | -8.17E+03 | 6959 | (0.06) |
| 58911 | 0.04 | 220 | 50.25 | 0.63 | 0.62 | 3.6 | 1.87 | 0.20 | 0.41 | 0.084 | 0.088 | 0.024 | 5.02E-04 | 7.62E+04 | 3.29E+04 | 6870 | 0.16 |
| 58822 | 0.04 | 220 | 62.1 | 0.81 | 0.78 | 4.11 | 2.03 | 0.26 | 0.53 | 0.077 | 0.081 | 0.031 | 7.04E-04 | 1.32E+05 | -2.32E+04 | 6781 | (0.09) |
| 58733 | 0.04 | 220 | 62.98 | 1.17 | 1 | 4.81 | 1.91 | 0.38 | 0.76 | 0.078 | 0.082 | 0.031 | 1.14E-03 | 2.18E+05 | -1.09E+05 | 6692 | (0.43) |
| 58706 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | | 0.054 | 0.057 | 0.019 | 7.79E-06 | 8.75E+03 | 9.93E+04 | 6667 | 0.80 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.38 | 2.09 | 0.37 | 0.75 | 0.039 | 0.041 | 0.012 | 1.79E-03 | 1.51E+05 | -4.19E+04 | 6617 | (0.38) |
| 58606 | 0.04 | 220 | 29.17 | 1.08 | 0.78 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.013 | 1.82E-03 | 1.43E+05 | -3.38E+04 | 6567 | (0.29) |
| 58506 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.59 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.017 | 1.23E-03 | 1.39E+05 | -3.02E+04 | 6467 | (0.21) |
| 58306 | 0.04 | 220 | 23.85 | 0.96 | 0.86 | 5.08 | 2.65 | 0.31 | 0.62 | 0.034 | 0.036 | 0.010 | 1.81E-03 | 1.30E+05 | -2.12E+04 | 6267 | (0.24) |
| 58106 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.81 | 0.58 | 2.63 | 0.035 | 0.037 | 0.011 | 3.22E-03 | 2.42E+05 | -1.33E+05 | 6067 | (1.47) |
| 57975 | 0.04 | 220 | 21.69 | 0.58 | 0.46 | 4.08 | 2.77 | 0.19 | 0.38 | 0.031 | 0.033 | 0.009 | 8.99E-04 | 5.86E+04 | 4.98E+04 | 5934 | 0.64 |
| 57804 | 0.07 | 220 | 31.33 | 0.67 | 0.29 | 2.58 | 3.46 | 0.22 | 0.44 | 0.026 | 0.083 | 0.042 | 2.28E-04 | 2.16E+04 | 8.75E+04 | 5763 | 0.81 |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.17 | 0.028 | 0.098 | 0.046 | 1.22E-04 | 1.23E+04 | 9.68E+04 | 5578 | 0.87 |
| 57554 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.57 | 4.76 | 0.20 | 0.33 | 0.022 | 0.077 | 0.033 | 2.98E-04 | 2.27E+04 | 8.63E+04 | 5517 | 1.03 |
| 57509 | 0.07 | 220 | 33.37 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | 0.10 | 0.028 | 0.096 | 0.046 | 8.77E-05 | 8.85E+03 | 1.00E+05 | 5468 | 0.92 |
| 57388 | 0.7 | 220 | 35.56 | 15.50 | 0.11 | 1.34 | 5.34 | 5.06 | | 0.004 | 1.894 | 4.907 | 3.53E-05 | 3.79E+03 | 1.05E+05 | 5347 | 0.92 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 1.00 | 0.026 | 0.091 | 0.041 | 4.53E-04 | 4.20E+04 | 6.71E+04 | 5147 | 0.71 |
| 57058 | 0.07 | 220 | 21.69 | 1.96 | 0.49 | 4.3 | 2.86 | 0.64 | 2.88 | 0.019 | 0.068 | 0.028 | 1.11E-03 | 7.26E+04 | 3.65E+04 | 5017 | 0.58 |
| 56979 | 0.07 | 220 | 26.79 | 1.21 | 0.38 | 3.6 | 2.92 | 0.39 | 4.72 | 0.023 | 0.081 | 0.035 | 8.05E-04 | 4.30E+04 | 6.62E+04 | 4938 | 0.66 |
| 56779 | 0.07 | 220 | 23.06 | 2.2 | 0.54 | 4.47 | 2.53 | 0.71 | 3.22 | 0.020 | 0.071 | 0.030 | 1.14E-03 | 7.92E+04 | 2.99E+04 | 4738 | 0.46 |
| 56731 | 0.02 | 220 | 17.93 | 0.33 | 0.74 | 6.01 | 2.04 | 0.11 | 0.11 | 0.048 | 0.011 | 0.002 | 2.59E-03 | 1.41E+05 | -3.16E+04 | 4690 | (0.63) |
| Average | | | 50.76 | 2.20 | 1.06 | 6.26 | 3.41 | | 3.03 | 0.070 | 0.127 | 0.061 | | | | | 0.51 |
| | | | | | | | | | | | | | | | | | |
| 56730 | Wardell Bridge | | | | | | | | Wardell Bridge | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.56 | 1 | 7.36 | 1.67 | 0.18 | | 0.048 | 0.011 | 0.002 | 4.38E-03 | 2.27E+05 | -1.27E+05 | 4665 | (2.54) |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.99 | 5.84 | | 0.019 | 0.067 | 0.027 | 1.16E-02 | 7.47E+05 | -6.38E+05 | 4629 | (10.80) |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.30 | | 0.022 | 0.077 | 0.033 | 3.88E-04 | 2.79E+04 | 8.12E+04 | 4584 | 1.17 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.27 | | 0.019 | 0.065 | 0.026 | 4.48E-04 | 2.82E+04 | 8.09E+04 | 4555 | 1.42 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.36 | 3.62 | 3.46 | 0.43 | | 0.019 | 0.066 | 0.027 | 7.25E-04 | 4.63E+04 | 6.28E+04 | 4533 | 1.09 |
| 56474 | 0.07 | 220 | 21.19 | 1.38 | 0.38 | 3.66 | 3.39 | 0.45 | | 0.019 | 0.066 | 0.027 | 7.53E-04 | 4.82E+04 | 6.08E+04 | 4433 | 1.06 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.06 | 2.88 | 0.58 | | 0.020 | 0.072 | 0.030 | 9.15E-04 | 6.41E+04 | 4.50E+04 | 4234 | 0.77 |
| 56200 | 0.07 | 220 | 34.8 | 0.38 | 0.2 | 2.01 | 3.56 | 0.13 | | 0.029 | 0.101 | 0.048 | 9.91E-05 | 1.04E+04 | 9.87E+04 | 4159 | 1.14 |
| 56100 | 0.07 | 220 | 27.56 | 0.67 | 0.26 | 2.6 | 3.61 | 0.22 | | 0.024 | 0.084 | 0.037 | 2.42E-04 | 2.05E+04 | 8.86E+04 | 4059 | 1.30 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.44 | | 0.017 | 0.060 | 0.023 | 8.74E-04 | 4.36E+04 | 6.95E+04 | 4033 | 1.31 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.66 | 3.96 | 0.49 | | 0.017 | 0.058 | 0.023 | 1.02E-03 | 5.67E+04 | 5.24E+04 | 4017 | 1.18 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.89 | 0.49 | | 0.021 | 0.074 | 0.031 | 7.12E-04 | 5.16E+04 | 5.75E+04 | 3959 | 1.01 |
| 55902 | 0.07 | 220 | 20.8 | 1.2 | 0.35 | 3.47 | 3.85 | 0.39 | | 0.019 | 0.065 | 0.026 | 6.08E-04 | 4.33E+04 | 6.58E+04 | 3861 | 1.37 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.48 | | 0.019 | 0.066 | 0.027 | 8.90E-04 | 5.70E+04 | 5.21E+04 | 3831 | 1.07 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.53 | | 0.019 | 0.067 | 0.027 | 9.21E-04 | 5.95E+04 | 4.95E+04 | 3759 | 1.03 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.65 | | 0.019 | 0.065 | 0.026 | 1.21E-03 | 7.57E+04 | 3.34E+04 | 3665 | 0.73 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.30 | | 0.019 | 0.067 | 0.027 | 5.08E-04 | 3.29E+04 | 7.62E+04 | 3565 | 1.66 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 1.22 | | 0.015 | 0.051 | 0.019 | 2.94E-03 | 1.40E+05 | -3.04E+04 | 3517 | (0.92) |
| 55506 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.20 | | 0.023 | 0.081 | 0.035 | 2.28E-04 | 1.84E+04 | 9.07E+04 | 3464 | 1.64 |
| 55406 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.40 | | 0.018 | 0.062 | 0.024 | 7.10E-04 | 4.17E+04 | 6.74E+04 | 3364 | 1.72 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.32 | | 0.020 | 0.072 | 0.030 | 5.05E-04 | 3.56E+04 | 7.36E+04 | 3265 | 1.82 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 0.40 | | 0.023 | 0.080 | 0.035 | 6.01E-04 | 4.81E+04 | 6.10E+04 | 3165 | 1.21 |
| 55108 | 0.07 | 220 | 17.84 | 1.78 | 0.43 | 4.16 | 4.02 | 0.58 | | 0.016 | 0.057 | 0.022 | 1.33E-03 | 7.20E+04 | 3.71E+04 | 3067 | 1.12 |
| 55005 | 0.07 | 220 | 23.25 | 1.16 | 0.38 | 3.4 | 3.48 | 0.38 | | 0.020 | 0.072 | 0.030 | 5.88E-04 | 4.13E+04 | 6.78E+04 | 2964 | 1.64 |
| 54905 | 0.07 | 220 | 22.83 | 1.34 | 0.39 | 3.6 | 3.03 | 0.44 | | 0.020 | 0.071 | 0.030 | 6.34E-04 | 4.38E+04 | 6.52E+04 | 2864 | 1.65 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.98 | 3.38 | 0.29 | | 0.022 | 0.076 | 0.033 | 3.57E-04 | 2.88E+04 | 8.22E+04 | 2764 | 1.99 |
| 54706 | 0.07 | 220 | 34.9 | 0.66 | 0.29 | 2.53 | 3.11 | 0.21 | | 0.029 | 0.102 | 0.048 | 1.84E-04 | 2.36E+04 | 8.88E+04 | 2664 | 1.59 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.75 | | 0.018 | 0.064 | 0.025 | 1.55E-03 | 9.46E+04 | 1.44E+04 | 2555 | 0.47 |
| 54511 | 0.07 | 220 | 24.21 | 2.76 | 0.63 | 4.8 | 2.78 | 0.90 | | 0.021 | 0.074 | 0.031 | 1.80E-03 | 1.24E+05 | -1.48E+04 | 2470 | (0.40) |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.48 | 2.21 | 0.10 | | 0.060 | 0.006 | 0.001 | 5.80E-03 | 3.06E+05 | -1.96E+05 | 2455 | (7.84) |
| 54440 | 0.015 | 220 | 13.79 | 0.23 | 0.77 | 6.74 | 2.56 | 0.07 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 1.86E+05 | -8.57E+04 | 2399 | (4.32) |
| 54431 | 0.015 | 220 | 12.88 | 0.23 | 0.74 | 6.7 | 2.54 | 0.07 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 1.78E+05 | -6.82E+04 | 2390 | (3.72) |
| Average | | | 22.00 | 1.78 | 0.50 | 4.24 | 3.28 | | | 0.024 | 0.063 | 0.026 | | | | | 0.05 |
| | | | | | | | | | | | | | | | | | |
| 54430 | RR Bridge | | | | | | | | RR Bridge | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 8.23 | 2.06 | 0.12 | | 0.046 | 0.006 | 0.001 | 7.73E-03 | 3.01E+05 | -1.92E+05 | 2355 | (10.54) |
| 54306 | 0.07 | 220 | 22.04 | 20.68 | 2.26 | 11.8 | 0.94 | 6.72 | | 0.020 | 0.069 | 0.028 | 1.33E-02 | 8.67E+05 | -7.78E+05 | 2264 | (25.98) |
| 54296 | 0.07 | 220 | 24.48 | 5.66 | 1 | 6.62 | 2.57 | 1.85 | | 0.021 | 0.075 | 0.032 | 4.41E-03 | 3.26E+05 | -2.17E+05 | 2255 | (8.56) |

By MHM Date 11/5/01 Subject BUREC SAMPLE CALCS Job No. 015014.00
Checked By ______ Date ______ Sheet 1 of 7

# I) BUREC METHOD: ARMORING

## A) FOR REACH COMOL TO WARDELL

Q = DOMINANT DISCHARGE = 220 cfs

B = CHANNEL WIDTH (est. avg.) = 30'

d = MEAN CHANNEL DEPTH = 5.4'

V = MEAN CHANNEL VEL = 8.3 fps

S = GRADIENT ≈ 1.5% = 0.015

FIND ARMORING SIZE = D = dia. in mm

### 1) Meyer-Peter, Muller

$$D = \frac{Sd}{K\left[\frac{n_s}{(D_{90})^{1/6}}\right]^{3/2}}$$

[Ref. 1, Eq. 14]

Where: $K = 0.19$ (English Units)

$n_s = 0.06$ (Manning's n)

$D_{90} = 250$ mm (Assumed from Ref 2)

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[1] Design of Small Dams, Bureau of Reclamation, U.S. Dept. of the Interior, 1987, Appendix A.

[2] Stream Stability at Highway Structures, 3RD Ed (HEC-20), Federal Highway Admin. Publication No. FHWA NHI 01-002, MARCH

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1) M-P, M (CONT'D)

$$D = \frac{(0.015)(5.4)}{0.19\left[\frac{0.06}{(250)^{1/6}}\right]^{3/2}} = \underline{\underline{115\ mm}} = 0.4'$$

2) COMPETENT BOTTOM VELOCITY

$V_b = 0.51\, D^{1/2}$ fps (Ref 1, Eq. 15)

Where $V_b$ = Competent Bottom Vel = 0.7 $V_{mean}$

D = Dia, in mm

$$D = 3.84\, V_b^2 = 3.84\,(0.7 \times 8.3)^2 = \underline{\underline{130\ mm}}$$

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3) CRITICAL TRACTIVE FORCE

$t.f. = \gamma_w d S$ [Ref. 1, Eq. 16]

Where $t.f.$ = TRACTIVE FORCE psf

$\gamma_w$ = unit weigh $H_2O$ = 62.4 pcf

$t.f. = (62.4)(5.4)(0.015) = 5.05$ psf

Use Figure A-20, Ref. 1 ⇒ 5 psf off scale

4) Shields Diagram:

$$\frac{T_c}{(\gamma_s - \gamma_w) D} = 0.06$$ (Ref. 1, Eq. 17)

Where $T_c = \gamma_w d S$ psf

$\gamma_s$ = Unit weight of particle = 165 pcf

$\gamma_w$ = 62.4 pcf

d = mean water depth

S = Slope

By MHM Date 11/5/01 Subject BuRec Job No. 0150014.00

Checked By______ Date______ Sheet 4 of 7

4) Shields Diag. (CONT'D)

$$D = \frac{(62.4)(5.4)(0.015)}{(0.06)(135-62.4)} = 0.82\ ft \times \frac{12\ in}{1\ ft} \times \frac{25.4\ mm}{1\ in}$$

$$= \underline{\underline{250\ mm}}$$

5) YANG INCIPIENT MOTION

$\frac{V_{CR}}{\omega} = 2.05$ [Ref. 1, Eq 18]

where $V_{CR}$ = CRITICAL AVG. WATER VEL @ INCIPIENT MOTION fps

$\omega$ = terminal fall velocity, fps

$= 6.01\ D^{1/2}$

$$\therefore D = 0.00659 (V_{CR})^2$$

$$= 0.00659 (8.3)^2$$

$$= 0.45\ ft = \underline{\underline{138\ mm}}$$

**4 x 4 Grid Sheet** **Kennedy/Jenks Consultants**

By MHM Date 11/5/01 Subject BUREC Job No. 015014.00
Checked By ______ Date ______ Sheet 5 of 7

6) MEAN RESULT OF 4 METHODS

$$D_{AVG} = \frac{115 + 130 + 250 + 138}{4} = 158 \text{ mm} = 0.52' \approx 6''$$

7) Depth of degradation to armor layer

$$Y_d = Y_a \left( \frac{1}{\Delta p} - 1 \right) \quad \left[ \text{Ref. 1, Eq. 13} \right]$$

where $Y_d$ = depth from orig. streambed to top of armoring layer

$Y_a$ = Thickness of armoring layer

$\Delta p$ = decimal pct. of mat'l larger than armoring size.

= 0.38

a) $Y_a$ = 3D or 0.5 ft, whichever is smaller (Ref. 1, p. 557)

$$\therefore 3(158) = \frac{474}{(12)(25.4)} = 1.56' \Rightarrow \text{use } 0.5'$$

By MHM Date 11/5/01 Subject BURCC Job No. 015014.00

Checked By Date Sheet 6 of 7

7) Depth of degradation (cont'd)

b) $y/d = 0.5\left[\frac{1}{0.38} - 1\right] = 0.82' \approx 10''$

By MHM Date 11/5/01 Subject BUREC Job No. 015014.00
Checked By _____ Date _____ Sheet 7 of 7

II) BUREC STABLE SLOPE METHOD

B) FOR REACH: DE COMER HEADWALL TO WARDELL

1) EVALUATE Limiting Slope

$$S_L = \frac{K\left(\frac{Q}{Q_B}\right)\left[\frac{n_s}{(D_{90})^{1/6}}\right]^{3/2}}{d} D_{50}$$ [Ref. 1, Eq. 25]

where $S_L$ = Limiting Slope

$K$ = coefficient = 0.19

$Q/Q_B$ = RATIO OF TOTAL FLOW (cfs) to flow over BED OF STREAM. $Q/Q_B = 1$ for wide CHANNEL.

ASSUME FOR CALABAZAS CRK

$Q/Q_B = 1$

$$S_L = \frac{(0.19)\,(1)\left[\frac{0.06}{(250)^{1/6}}\right]^{3/2}}{(5.4)} (110)$$

$= 0.014$ MATCHES SLOPE FOR 1971 PRECONSTRUCTION CONDITIONS

# EXISTING CONDITION

ATTACHMENT 1

BUREC

**Input Values**

Factors
Ks 0.03
Ku 1.486
K(mpm) 60.1
Unit Weight H20 (pcf) 62.4
Unit Weight SED (pcf) 165
D80 (mm) 250
D80 (ft) 0.820
D50 (mm) 110.0
D50 (ft) 0.361

Upstream Sediment Supply
Based on estimate of sed supply from USGS 1975 Report

Est. total 10000 tons
Sed Loading Period 50 days — Assume Sed Load from 3 or 4 Major Storms in Water Year
Time Δt 4320000 sec

Sed Volume 1.21E+05 cu. ft.

$Q_s$ 0.028 cfs

Assume Sediment Porosity 0.4

Exponents
a 3.036E-06
b 3.419
c 0.667

Prospect Rd Sta 52041

2.3 YR RAS Input Data

| River Sta | Mann Wtd Chnl | Q Channel (cfs) | 2.3 Yr Top W Chnl (ft) | Shear Chan (lb/sq ft) | Froude # Chl | Vel Chnl (ft/s) | 2.3Yr Max Chl Dpth (ft) | Incipient Motion (ft) | Comer to Wardell Depth to Armor (ft) | Eq Slope Shields (No Sed Supply) (ft/ft) | Eq Slope (MP-M) (No Sed Supply) (ft/ft) | Eq Slope (Regression) (Sed Supply) (ft/ft) | Transport Capacity $q_s = aV^bY^c$ ($ft^2/s$) | Sediment Outflow $q_sW\Delta t$ ($ft^3$) | Net Change ΔV= Supply - Outflow ($ft^3$) | Distance to Prospect Rd. (ft) | ExCond Base El. Change ΔZ (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69896 | 0.04 | 220 | 9.39 | 3.09 | 1.01 | 9.15 | 3.59 | 1.00 | | 0.015 | 0.018 | 0.002 | 1.78E-02 | 7.23E+05 | -6.02E+05 | 17855 | (6.05) |
| 69496 | 0.04 | 220 | 17.7 | 2.63 | 1.16 | 8.12 | 2.19 | 0.65 | | 0.028 | 0.028 | 0.005 | 7.72E-03 | 5.90E+05 | -4.69E+05 | 17455 | (2.53) |
| 69196 | 0.04 | 220 | 30.87 | 1.18 | 0.82 | 5.34 | 2.01 | 0.38 | | 0.042 | 0.045 | 0.010 | 1.71E-03 | 2.28E+05 | -1.07E+05 | 17155 | (0.34) |
| 68896 | 0.04 | 220 | 28.88 | 1.51 | 0.94 | 6 | 1.54 | 0.48 | | 0.040 | 0.042 | 0.009 | 2.02E-03 | 2.50E+05 | -1.29E+05 | 16855 | (0.45) |
| 68396 | 0.04 | 220 | 21.84 | 1.81 | 1 | 6.88 | 3.18 | 0.62 | | 0.031 | 0.033 | 0.007 | 6.05E-03 | 5.71E+05 | -4.50E+05 | 16355 | (2.10) |
| 67796 | 0.04 | 220 | 13.49 | 4.01 | 1.39 | 10.05 | 2.25 | 1.30 | | 0.021 | 0.022 | 0.004 | 1.64E-02 | 9.55E+05 | -8.34E+05 | 15755 | (6.54) |
| 67396 | 0.04 | 220 | 27.93 | 1.29 | 0.83 | 5.61 | 2.08 | 0.42 | | 0.038 | 0.041 | 0.008 | 2.08E-03 | 2.52E+05 | -1.30E+05 | 15355 | (0.51) |
| 66896 | 0.04 | 220 | 29.36 | 1.69 | 1.01 | 6.28 | 2.14 | 0.55 | | 0.040 | 0.043 | 0.009 | 3.14E-03 | 3.99E+05 | -2.77E+05 | 14855 | (1.05) |
| 66865 | 0.04 | 220 | 17.87 | 0.83 | 0.53 | 4.83 | 2.75 | 0.27 | | 0.026 | 0.028 | 0.005 | 1.38E-03 | 1.23E+05 | -1.65E+03 | 14824 | (0.01) |
| 66850 | 0.04 | 220 | 24.97 | 0.49 | 0.43 | 3.74 | 3.48 | 0.16 | | 0.035 | 0.037 | 0.008 | 8.14E-04 | 8.78E+04 | 3.34E+04 | 14809 | 0.15 |
| 66796 | 0.04 | 220 | 23.77 | 1.84 | 1 | 6.69 | 1.57 | 0.60 | | 0.034 | 0.036 | 0.007 | 2.98E-03 | 3.06E+05 | -1.85E+05 | 14755 | (0.88) |
| 66396 | 0.04 | 220 | 21.6 | 2.08 | 1.06 | 7.16 | 2.23 | 0.68 | | 0.031 | 0.033 | 0.006 | 5.10E-03 | 4.78E+05 | -3.55E+05 | 14355 | (1.91) |
| 66246 | 0.04 | 220 | 25.52 | 0.87 | 0.63 | 4.8 | 3.59 | 0.28 | | 0.036 | 0.038 | 0.008 | 1.96E-03 | 2.16E+05 | -9.52E+04 | 14205 | (0.44) |
| 66245 | Vista Regina Bridge | | | | | | | | | | | | | | | | |
| 66216 | 0.04 | 220 | 21.16 | 1.98 | 1.01 | 6.96 | 2.81 | 0.64 | | 0.030 | 0.032 | 0.006 | 5.71E-03 | 5.22E+05 | -4.01E+05 | 14175 | (2.23) |
| 66096 | 0.04 | 220 | 27.38 | 3.34 | 1.54 | 8.5 | 1.81 | 1.09 | | 0.038 | 0.040 | 0.009 | 7.65E-03 | 9.05E+05 | -7.84E+05 | 14055 | (3.39) |
| 65796 | 0.04 | 220 | 28.44 | 1.75 | 1 | 6.48 | 1.61 | 0.57 | | 0.037 | 0.039 | 0.008 | 2.70E-03 | 3.09E+05 | -1.88E+05 | 13755 | (0.86) |
| 65196 | 0.04 | 220 | 34.85 | 0.88 | 0.69 | 4.59 | 1.75 | 0.28 | | 0.047 | 0.049 | 0.011 | 9.04E-04 | 1.36E+05 | -1.48E+04 | 13155 | (0.05) |
| 64596 | 0.04 | 220 | 9.88 | 2.97 | 1.01 | 8.98 | 3.53 | 0.96 | | 0.016 | 0.017 | 0.003 | 1.65E-02 | 7.03E+05 | -5.82E+05 | 12555 | (7.82) |
| 63996 | 0.04 | 220 | 17.45 | 1.85 | 0.91 | 6.97 | 2.69 | 0.60 | | 0.026 | 0.027 | 0.005 | 5.47E-03 | 4.13E+05 | -2.91E+05 | 11955 | (2.33) |
| 63696 | 0.04 | 220 | 17.68 | 2.14 | 1.01 | 7.42 | 2.74 | 0.70 | | 0.026 | 0.028 | 0.005 | 6.89E-03 | 5.28E+05 | -4.06E+05 | 11655 | (3.27) |
| 63620 | 0.04 | 220 | 22.62 | 0.6 | 0.47 | 4.13 | 2.87 | 0.19 | | 0.032 | 0.034 | 0.007 | 9.67E-04 | 9.45E+04 | 2.87E+04 | 11579 | 0.17 |
| 63596 | 0.04 | 220 | 28.96 | 0.33 | 0.34 | 3.07 | 3.27 | 0.11 | | 0.040 | 0.042 | 0.009 | 3.93E-04 | 4.91E+04 | 7.21E+04 | 11555 | 0.36 |
| 63396 | 0.04 | 220 | 12.45 | 2.59 | 1.01 | 8.32 | 2.87 | 0.84 | | 0.019 | 0.020 | 0.003 | 1.08E-02 | 5.70E+05 | -4.49E+05 | 11355 | (5.29) |
| 62796 | 0.04 | 220 | 17.62 | 2.63 | 1.14 | 8.05 | 2.48 | 0.85 | | 0.026 | 0.028 | 0.005 | 8.35E-03 | 6.35E+05 | -5.14E+05 | 10755 | (4.52) |
| 62690 | 0.04 | 220 | 19.56 | 1.51 | 0.82 | 6.22 | 1.9 | 0.49 | | 0.028 | 0.030 | 0.006 | 2.74E-03 | 2.32E+05 | -1.11E+05 | 10649 | (0.88) |
| 62689 | Pierce Bridge | | | | | | | | Pierce Bridge | | | | | | | | |
| 62662 | 0.04 | 220 | 19.95 | 2.1 | 1.01 | 7.13 | 2 | 0.68 | | 0.029 | 0.031 | 0.006 | 4.57E-03 | 3.94E+05 | -2.73E+05 | 10621 | (2.15) |
| 62631 | 0.04 | 220 | 21.29 | 4.9 | 1.63 | 10.37 | 2.02 | 1.59 | | 0.031 | 0.032 | 0.006 | 1.86E-02 | 1.53E+06 | -1.41E+06 | 10590 | (10.40) |
| 62596 | 0.04 | 220 | 26.38 | 1.99 | 1.09 | 6.82 | 2.05 | 0.65 | | 0.037 | 0.039 | 0.008 | 4.01E-03 | 4.57E+05 | -3.36E+05 | 10555 | (2.01) |
| 62096 | 0.04 | 220 | 47.48 | 0.78 | 0.7 | 4.17 | 1.99 | 0.25 | | 0.061 | 0.064 | 0.016 | 7.24E-04 | 1.49E+05 | -2.74E+04 | 10055 | (0.10) |
| 61896 | 0.04 | 220 | 25.73 | 1.45 | 0.86 | 5.97 | 2.3 | 0.47 | | 0.036 | 0.038 | 0.008 | 2.81E-03 | 3.13E+05 | -1.92E+05 | 9855 | (1.28) |
| 61396 | 0.04 | 220 | 21.9 | 1.06 | 0.69 | 5.34 | 2.67 | 0.34 | | 0.031 | 0.033 | 0.007 | 2.19E-03 | 2.07E+05 | -8.57E+04 | 9355 | (0.70) |
| 60896 | 0.04 | 220 | 21.85 | 1.91 | 1 | 6.87 | 2.95 | 0.62 | | 0.031 | 0.033 | 0.007 | 5.64E-03 | 5.33E+05 | -4.11E+05 | 8855 | (3.54) |
| 60396 | 0.04 | 220 | 39.21 | 0.26 | 0.33 | 2.89 | 3.03 | 0.08 | | 0.052 | 0.055 | 0.013 | 2.34E-04 | 3.96E+04 | 8.16E+04 | 8355 | 0.42 |
| 59796 | 0.04 | 220 | 39.94 | 1.29 | 0.93 | 5.35 | 2.06 | 0.42 | | 0.053 | 0.056 | 0.013 | 1.77E-03 | 3.06E+05 | -1.85E+05 | 7755 | (0.99) |
| 59500 | 0.04 | 220 | 25.34 | 1.79 | 1 | 6.58 | 1.73 | 0.58 | | 0.036 | 0.038 | 0.008 | 3.03E-03 | 3.32E+05 | -2.11E+05 | 7459 | (1.86) |
| 59396 | 0.04 | 220 | 60.54 | 0.05 | 0.14 | 1.26 | 3.89 | 0.02 | | 0.085 | 0.089 | 0.025 | 2.17E-05 | 6.53E+03 | 1.15E+05 | 7355 | 0.37 |
| 59300 | 0.04 | 220 | 43.32 | 0.44 | 0.47 | 3.32 | 2.57 | 0.14 | | 0.056 | 0.060 | 0.015 | 4.17E-04 | 7.79E+04 | 4.33E+04 | 7259 | 0.23 |
| 59100 | 0.04 | 220 | 38.11 | 1.53 | 1.02 | 5.78 | 2.08 | 0.50 | | 0.050 | 0.053 | 0.013 | 2.29E-03 | 3.77E+05 | -2.56E+05 | 7059 | (1.58) |
| 59096 | 0.04 | 220 | 39.96 | 0.24 | 0.31 | 2.59 | 2.83 | 0.08 | | 0.053 | 0.056 | 0.013 | 1.94E-04 | 3.35E+04 | 8.78E+04 | 7055 | 0.52 |
| 59036 | 0.04 | 220 | 31.84 | 0.53 | 0.48 | 3.74 | 2.82 | 0.17 | | 0.043 | 0.046 | 0.010 | 6.78E-04 | 9.33E+04 | 2.79E+04 | 6995 | 0.21 |
| | | | 34.12 | 1.35 | 0.79 | 5.20 | 2.47 | | | 0.05 | 0.05 | 0.01 | | | | | (1.52) |
| 59035 | Comer Bridge | | | | | | | | Comer Bridge | | | | | | | | |
| 59000 | 0.04 | 220 | 31.11 | 0.9 | 0.66 | 4.7 | 2.31 | 0.29 | 0.58 | 0.042 | 0.045 | 0.010 | 1.25E-03 | 1.68E+05 | -4.63E+04 | 6959 | (0.36) |
| 58911 | 0.04 | 220 | 50.25 | 0.63 | 0.62 | 3.6 | 1.67 | 0.20 | 0.41 | 0.064 | 0.068 | 0.017 | 5.02E-04 | 1.09E+05 | 1.23E+04 | 6870 | 0.06 |
| 58822 | 0.04 | 220 | 62.1 | 0.81 | 0.78 | 4.11 | 2.03 | 0.26 | 0.53 | 0.077 | 0.081 | 0.022 | 7.04E-04 | 1.89E+05 | -6.78E+04 | 6781 | (0.27) |
| 58733 | 0.04 | 220 | 62.98 | 1.17 | 1 | 4.81 | 1.91 | 0.38 | 0.76 | 0.078 | 0.082 | 0.022 | 1.14E-03 | 3.11E+05 | -1.90E+05 | 6692 | (0.75) |
| DOE → 58708 | 0.04 | 220 | 41.39 | 0.13 | 0.21 | 1.95 | 3.03 | 0.04 | | 0.054 | 0.057 | 0.014 | 7.79E-05 | 1.38E+04 | 1.07E+05 | 6667 | 0.65 |
| 58658 | 0.04 | 220 | 27.87 | 1.15 | 0.78 | 5.38 | 2.09 | 0.37 | 0.75 | 0.039 | 0.041 | 0.009 | 1.79E-03 | 2.16E+05 | -9.44E+04 | 6617 | (0.85) |
| 58608 | 0.04 | 220 | 29.17 | 1.08 | 0.76 | 5.18 | 2.13 | 0.35 | 0.70 | 0.040 | 0.042 | 0.009 | 1.62E-03 | 2.04E+05 | -8.29E+04 | 6567 | (0.72) |
| 58508 | 0.04 | 220 | 37.41 | 0.89 | 0.72 | 4.58 | 2.5 | 0.29 | 0.58 | 0.050 | 0.053 | 0.012 | 1.23E-03 | 1.99E+05 | -7.77E+04 | 6467 | (0.54) |
| 58308 | 0.04 | 220 | 23.85 | 0.96 | 0.66 | 5.06 | 2.65 | 0.31 | 0.62 | 0.034 | 0.036 | 0.007 | 1.81E-03 | 1.66E+05 | -6.50E+04 | 6267 | (0.72) |
| 58108 | 0.04 | 220 | 24.86 | 1.8 | 1.01 | 6.6 | 1.61 | 0.58 | 2.63 | 0.035 | 0.037 | 0.008 | 3.22E-03 | 3.46E+05 | -2.25E+05 | 6067 | (2.48) |
| 57975 | 0.04 | 220 | 21.89 | 0.58 | 0.46 | 4.06 | 2.77 | 0.19 | 0.36 | 0.031 | 0.033 | 0.007 | 6.99E-04 | 8.51E+04 | 3.62E+04 | 5934 | 0.46 |
| 57804 | 0.07 | 220 | 31.33 | 0.67 | 0.28 | 2.58 | 3.48 | 0.22 | 0.44 | 0.026 | 0.083 | 0.031 | 2.28E-04 | 3.08E+04 | 9.04E+04 | 5763 | 0.83 |
| 57619 | 0.07 | 220 | 33.39 | 0.4 | 0.2 | 2.04 | 4.24 | 0.13 | 0.17 | 0.028 | 0.086 | 0.033 | 1.22E-04 | 1.75E+04 | 1.04E+05 | 5578 | 0.93 |
| 57558 | 0.07 | 220 | 25.4 | 0.63 | 0.25 | 2.57 | 4.78 | 0.20 | 0.33 | 0.022 | 0.077 | 0.024 | 2.98E-04 | 3.25E+04 | 8.87E+04 | 5517 | 1.06 |
| 57509 | 0.07 | 220 | 33.37 | 0.31 | 0.17 | 1.82 | 4.56 | 0.10 | 0.10 | 0.028 | 0.088 | 0.033 | 8.77E-05 | 1.28E+04 | 1.09E+05 | 5468 | 0.99 |
| 57388 | 0.7 | 220 | 35.55 | 15.59 | 0.11 | 1.34 | 5.34 | 5.06 | | 0.004 | 1.984 | 3.534 | 3.53E-05 | 5.42E+03 | 1.16E+05 | 5347 | 1.02 |
| 57188 | 0.07 | 220 | 30.63 | 1.25 | 0.41 | 3.38 | 2.64 | 0.41 | 1.00 | 0.026 | 0.091 | 0.030 | 4.53E-04 | 6.00E+04 | 6.12E+04 | 5147 | 0.65 |
| 57058 | 0.07 | 220 | 21.69 | 1.96 | 0.49 | 4.3 | 2.86 | 0.64 | 2.89 | 0.019 | 0.068 | 0.020 | 1.11E-03 | 1.04E+05 | 1.75E+04 | 5017 | 0.27 |
| 56879 | 0.07 | 220 | 26.79 | 1.21 | 0.38 | 3.4 | 2.92 | 0.39 | 4.72 | 0.023 | 0.081 | 0.025 | 5.05E-04 | 5.84E+04 | 6.28E+04 | 4838 | 0.79 |
| 56776 | 0.07 | 220 | 23.05 | 2.2 | 0.54 | 4.47 | 2.53 | 0.71 | 3.22 | 0.020 | 0.071 | 0.021 | 1.14E-03 | 1.13E+05 | 8.08E+03 | 4735 | 0.12 |
| 56731 | 0.02 | 220 | 17.83 | 0.33 | 0.74 | 6.01 | 2.04 | 0.11 | 0.11 | 0.048 | 0.011 | 0.001 | 2.59E-03 | 2.01E+05 | -7.97E+04 | 4690 | (1.58) |
| | AVG. – | | 50.78 | 2.20 | 1.08 | 8.26 | 5.41 – | | | 0.07 | 0.13 | 0.04 | | | | | -0.08 |
| 56730 | Wardell Bridge | | | | | | | | Wardell Bridge | | | | | | | | |
| 56706 | 0.02 | 220 | 17.94 | 0.55 | 1 | 7.36 | 1.67 | 0.18 | | 0.048 | 0.011 | 0.001 | 4.36E-03 | 3.38E+05 | -2.17E+05 | 4665 | (4.32) |
| 56670 | 0.07 | 220 | 21.29 | 17.99 | 2.05 | 11.19 | 0.98 | 5.84 | | 0.019 | 0.087 | 0.020 | 1.16E-02 | 1.07E+06 | -9.47E+05 | 4629 | (16.01) |
| 56625 | 0.07 | 220 | 25.15 | 0.92 | 0.31 | 3.02 | 3.22 | 0.30 | | 0.022 | 0.077 | 0.024 | 3.86E-04 | 3.96E+04 | 8.14E+04 | 4584 | 1.18 |
| 56596 | 0.07 | 220 | 20.8 | 0.83 | 0.27 | 2.94 | 4.51 | 0.27 | | 0.019 | 0.065 | 0.019 | 4.48E-04 | 4.02E+04 | 8.10E+04 | 4555 | 1.42 |
| 56574 | 0.07 | 220 | 21.14 | 1.33 | 0.38 | 3.62 | 3.48 | 0.43 | | 0.019 | 0.068 | 0.019 | 7.25E-04 | 6.62E+04 | 5.50E+04 | 4533 | 0.98 |
| 56474 | 0.07 | 220 | 21.19 | 1.39 | 0.39 | 3.68 | 2.39 | 0.45 | | 0.019 | 0.068 | 0.019 | 7.53E-04 | 6.89E+04 | 5.23E+04 | 4433 | 0.93 |
| 56275 | 0.07 | 220 | 23.16 | 1.78 | 0.47 | 4.08 | 2.88 | 0.58 | | 0.020 | 0.072 | 0.022 | 9.15E-04 | 9.15E+04 | 2.97E+04 | 4234 | 0.50 |
| 56200 | 0.07 | 220 | 34.8 | 0.39 | 0.2 | 2.01 | 3.55 | 0.13 | | 0.029 | 0.101 | 0.034 | 9.91E-05 | 1.49E+04 | 1.06E+05 | 4159 | 1.22 |
| 56100 | 0.07 | 220 | 27.95 | 0.67 | 0.26 | 2.6 | 3.61 | 0.22 | | 0.024 | 0.084 | 0.027 | 2.42E-04 | 2.93E+04 | 9.19E+04 | 4059 | 1.35 |
| 56074 | 0.07 | 220 | 18.75 | 1.34 | 0.36 | 3.65 | 4.16 | 0.44 | | 0.017 | 0.060 | 0.017 | 8.74E-04 | 7.08E+04 | 5.04E+04 | 4033 | 1.11 |
| 56058 | 0.07 | 220 | 18.4 | 1.51 | 0.39 | 3.86 | 3.98 | 0.49 | | 0.017 | 0.059 | 0.016 | 1.02E-03 | 8.10E+04 | 4.02E+04 | 4017 | 0.91 |
| 56000 | 0.07 | 220 | 23.94 | 1.51 | 0.43 | 3.77 | 2.69 | 0.49 | | 0.021 | 0.074 | 0.022 | 7.12E-04 | 7.37E+04 | 4.78E+04 | 3959 | 0.84 |
| 55902 | 0.07 | 220 | 20.6 | 1.2 | 0.35 | 3.47 | 3.85 | 0.39 | | 0.019 | 0.065 | 0.019 | 6.66E-04 | 6.18E+04 | 5.94E+04 | 3861 | 1.23 |
| 55872 | 0.07 | 220 | 21.18 | 1.47 | 0.4 | 3.79 | 3.66 | 0.48 | | 0.019 | 0.066 | 0.019 | 8.90E-04 | 8.14E+04 | 3.98E+04 | 3831 | 0.82 |
| 55800 | 0.07 | 220 | 21.38 | 1.62 | 0.43 | 3.93 | 3.3 | 0.53 | | 0.019 | 0.067 | 0.020 | 9.21E-04 | 8.51E+04 | 3.61E+04 | 3759 | 0.75 |
| 55706 | 0.07 | 220 | 20.75 | 2.01 | 0.49 | 4.35 | 3.02 | 0.65 | | 0.019 | 0.065 | 0.019 | 1.21E-03 | 1.08E+05 | 1.30E+04 | 3665 | 0.29 |
| 55606 | 0.07 | 220 | 21.43 | 0.91 | 0.3 | 3.07 | 4.4 | 0.30 | | 0.019 | 0.067 | 0.020 | 5.08E-04 | 4.70E+04 | 7.42E+04 | 3565 | 1.62 |
| 55558 | 0.07 | 220 | 15.69 | 3.77 | 0.66 | 5.84 | 2.64 | 1.22 | | 0.015 | 0.051 | 0.014 | 2.94E-03 | 1.99E+05 | -7.81E+04 | 3517 | (2.36) |
| 55505 | 0.07 | 220 | 26.61 | 0.61 | 0.24 | 2.5 | 3.93 | 0.20 | | 0.023 | 0.081 | 0.025 | 2.28E-04 | 2.62E+04 | 9.50E+04 | 3464 | 1.72 |
| 55405 | 0.07 | 220 | 19.43 | 1.23 | 0.34 | 3.51 | 3.82 | 0.40 | | 0.018 | 0.062 | 0.018 | 7.10E-04 | 5.98E+04 | 6.16E+04 | 3364 | 1.57 |
| 55306 | 0.07 | 220 | 23.22 | 0.98 | 0.32 | 3.14 | 4 | 0.32 | | 0.020 | 0.072 | 0.022 | 5.06E-04 | 5.07E+04 | 7.05E+04 | 3265 | 1.55 |
| 55206 | 0.07 | 220 | 26.46 | 1.22 | 0.38 | 3.4 | 3.57 | 0.40 | | 0.023 | 0.080 | 0.025 | 6.01E-04 | 6.87E+04 | 5.25E+04 | 3165 | 1.05 |
| 55108 | 0.07 | 220 | 17.94 | 1.78 | 0.43 | 4.18 | 4.02 | 0.58 | | 0.018 | 0.057 | 0.016 | 1.33E-03 | 1.03E+05 | 1.83E+04 | 3067 | 0.56 |
| 55005 | 0.07 | 220 | 23.25 | 1.18 | 0.36 | 3.4 | 3.48 | 0.38 | | 0.020 | 0.072 | 0.022 | 5.88E-04 | 5.90E+04 | 6.22E+04 | 2964 | 1.50 |
| 54905 | 0.07 | 220 | 22.93 | 1.34 | 0.39 | 3.6 | 3.03 | 0.44 | | 0.020 | 0.071 | 0.021 | 6.34E-04 | 6.28E+04 | 5.84E+04 | 2864 | 1.48 |
| 54805 | 0.07 | 220 | 24.92 | 0.88 | 0.3 | 2.96 | 3.38 | 0.29 | | 0.022 | 0.076 | 0.023 | 3.57E-04 | 3.84E+04 | 8.28E+04 | 2764 | 2.00 |
| 54705 | 0.07 | 220 | 34.9 | 0.66 | 0.28 | 2.53 | 3.11 | 0.21 | | 0.029 | 0.102 | 0.035 | 1.84E-04 | 2.93E+04 | 9.20E+04 | 2664 | 1.65 |
| 54596 | 0.07 | 220 | 20.17 | 2.3 | 0.53 | 4.61 | 3.21 | 0.75 | | 0.018 | 0.064 | 0.018 | 1.55E-03 | 1.35E+05 | -1.40E+04 | 2555 | (0.45) |
| 54511 | 0.07 | 220 | 24.21 | 2.78 | 0.63 | 4.9 | 2.78 | 0.90 | | 0.021 | 0.074 | 0.023 | 1.69E-03 | 1.77E+05 | -5.53E+04 | 2470 | (1.54) |
| 54496 | 0.015 | 220 | 17.38 | 0.3 | 1.01 | 7.45 | 2.21 | 0.10 | | 0.060 | 0.006 | 0.001 | 5.80E-03 | 4.35E+05 | -3.14E+05 | 2455 | (12.28) |
| 54440 | 0.015 | 220 | 13.78 | 0.23 | 0.77 | 6.74 | 2.58 | 0.07 | | 0.049 | 0.006 | 0.001 | 4.67E-03 | 2.78E+05 | -1.57E+05 | 2399 | (7.92) |
| 54431 | 0.015 | 220 | 12.96 | 0.23 | 0.74 | 6.7 | 2.54 | 0.07 | | 0.046 | 0.006 | 0.001 | 4.55E-03 | 2.55E+05 | -1.33E+05 | 2390 | (7.18) |
| | | | 22.00 | 1.78 | 0.50 | 4.24 | 3.28 | | | 0.02 | 0.08 | 0.02 | | | | | -0.74 |
| 54430 | RR Bridge | | | | | | | | RR Bridge | | | | | | | | |
| 54396 | 0.015 | 220 | 12.87 | 0.37 | 1.01 | 6.23 | 2.08 | 0.12 | | 0.046 | 0.006 | 0.000 | 7.73E-03 | 4.30E+05 | -3.09E+05 | 2355 | (16.36) |
| 54305 | 0.07 | 220 | 22.04 | 20.68 | 2.28 | 11.8 | 0.94 | 6.72 | | 0.020 | 0.089 | 0.020 | 1.33E-02 | 1.27E+06 | -1.15E+06 | 2264 | (38.28) |
| 54296 | 0.07 | 220 | 24.45 | 5.68 | 1 | 6.62 | 2.57 | 1.85 | | 0.021 | 0.075 | 0.023 | 4.41E-03 | 4.66E+05 | -3.45E+05 | 2255 | (10.42) |

2 mi.

½ mi.

BUREC ANALYSIS

0.9 mi.

COMER SEDIMENT ANALYSIS
ATTACHMENT 1
(~~Ref 2~~)
SEE FHWA HEC-20 3RD Ed.

BURCE

*ESTIMATED CURVE:
CALABAZAS CREEK
ABOVE PROSPECT
CREEK

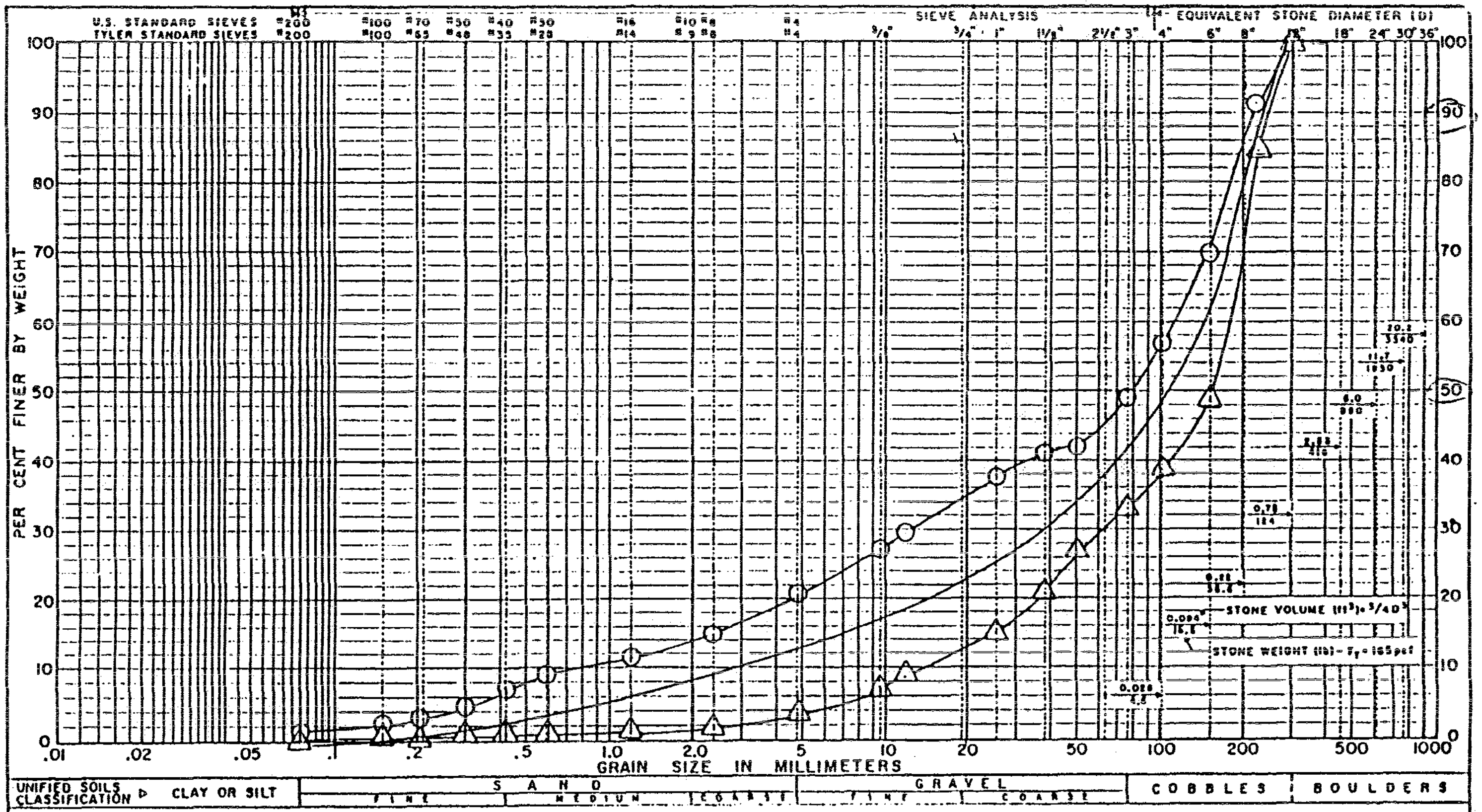


PLATE NO.

| SYMBOL | LOCATION | DESCRIPTION OF SAMPLE |
|---|---|---|
| ⊙ | UPSTREAM SITE | DARK BROWN COBBLES, SOME GRAVEL, SOME COARSE TO FINE SAND |
| △ | DOWNSTREAM SITE | DARK GRAY COBBLES, SOME GRAVEL, TRACE SAND |

GRADATION CURVES
RIVER GRAVEL AND SAND

PLATE NO.

Figure E.5. Bed material size gradation curves.

ATTACHMENT 3

# CALABAZAS CREEK GRADE

BURIC
SAMPLE
CALCS

KENNEDY/JENKS CONSULTANTS

Project: Comer Basin
Task: Equilibrium Slope Calculation
1971 Grade of Calabazas Creek

Prepared by: NEN
Date Prepared: 10/09/01
K/J Proj. No.: 015014.00 G 91

## SECTION 1:

**Upstream to Pierce Rd. #1**

**Total Length: 6100 ft**

**Avg. Grade: 2.2 %**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 45 | 566 | to | 55 | 550 | 1000 ft | 1.6 % | 16 % |
| 55 | 550 | to | 64 | 523 | 900 ft | 3.0 % | 15 % |
| 64 | 523 | to | 84 | 479 | 2000 ft | 2.2 % | 33 % |
| 84 | 479 | to | 106 | 434 | 2200 ft | 2.0 % | 36 % |

## SECTION 2:

**Pierce Rd. #1 to Pierce Rd. #2**

**Total Length: 930 ft**

**Avg. Grade: 2.0 %**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 106 | 434 | to | 115 | 415 | 930 ft | 2.0 % | 100 % |

## SECTION 3:

**Pierce Rd. #2 to Comer Dr.**

**Total Length: 3690 ft**

**Avg. Grade: 1.3 %**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 115 | 415.0 | to | 138 | 379.5 | 2270 ft | 1.6 % | 62 % |
| 138 | 379.5 | to | 144 | 377.5 | 600 ft | 0.3 % | 16 % |
| 144 | 377.5 | to | 148 | 368.5 | 400 ft | 2.3 % | 11 % |
| 148 | 368.5 | to | 152 | 366.3 | 420 ft | 0.5 % | 11 % |

## SECTION 4:

**Comer Dr. to Wardell Rd.**

**Total Length: 2300 ft**

**Avg. Grade: 1.4 %**

| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 152 | 366.3 | to | 158 | 353.8 | 580 ft | 2.2 % | 25 % |
| 158 | 353.8 | to | 174 | 336.0 | 1645 ft | 1.1 % | 72 % |
| 174 | 336.0 | to | 175 | 333.5 | 75 ft | 3.3 % | 3 % |

## SECTION 5:

**Wardell Rd. to SPRR**

**Total Length: 2275 ft**

**Avg. Grade: 1.0 %**

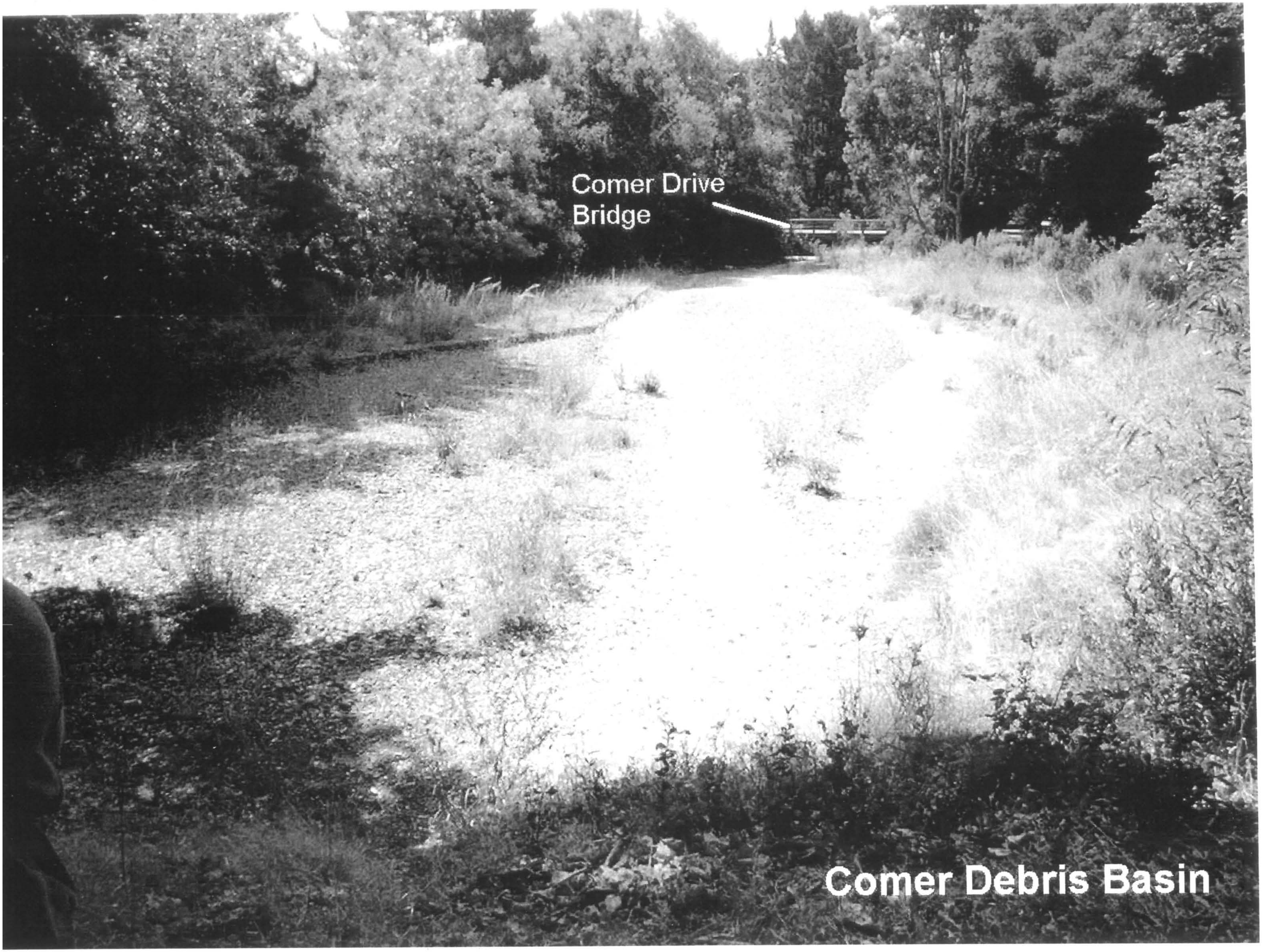
| Station (100 ft) | Elev (ft) | | Station (100 ft) | Elev (ft) | Station Separation | Slope | Percentage of Section Length |
|---|---|---|---|---|---|---|---|
| 175 | 333.5 | to | 197.95 | 311.5 | 2275 ft | 1.0 % | 100 % |

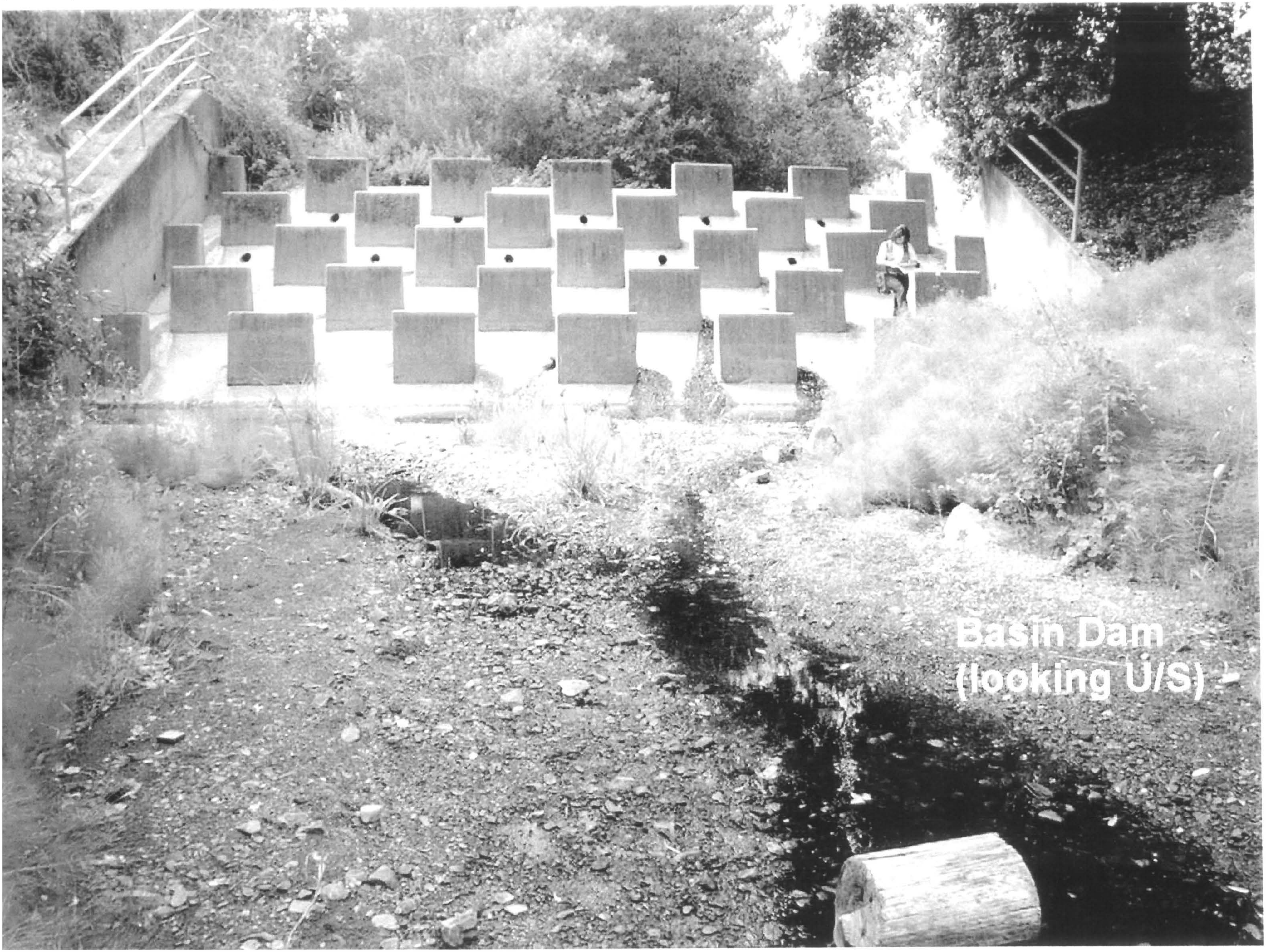
**Total Average Grade of Calabazas Creek: 1.7 %**

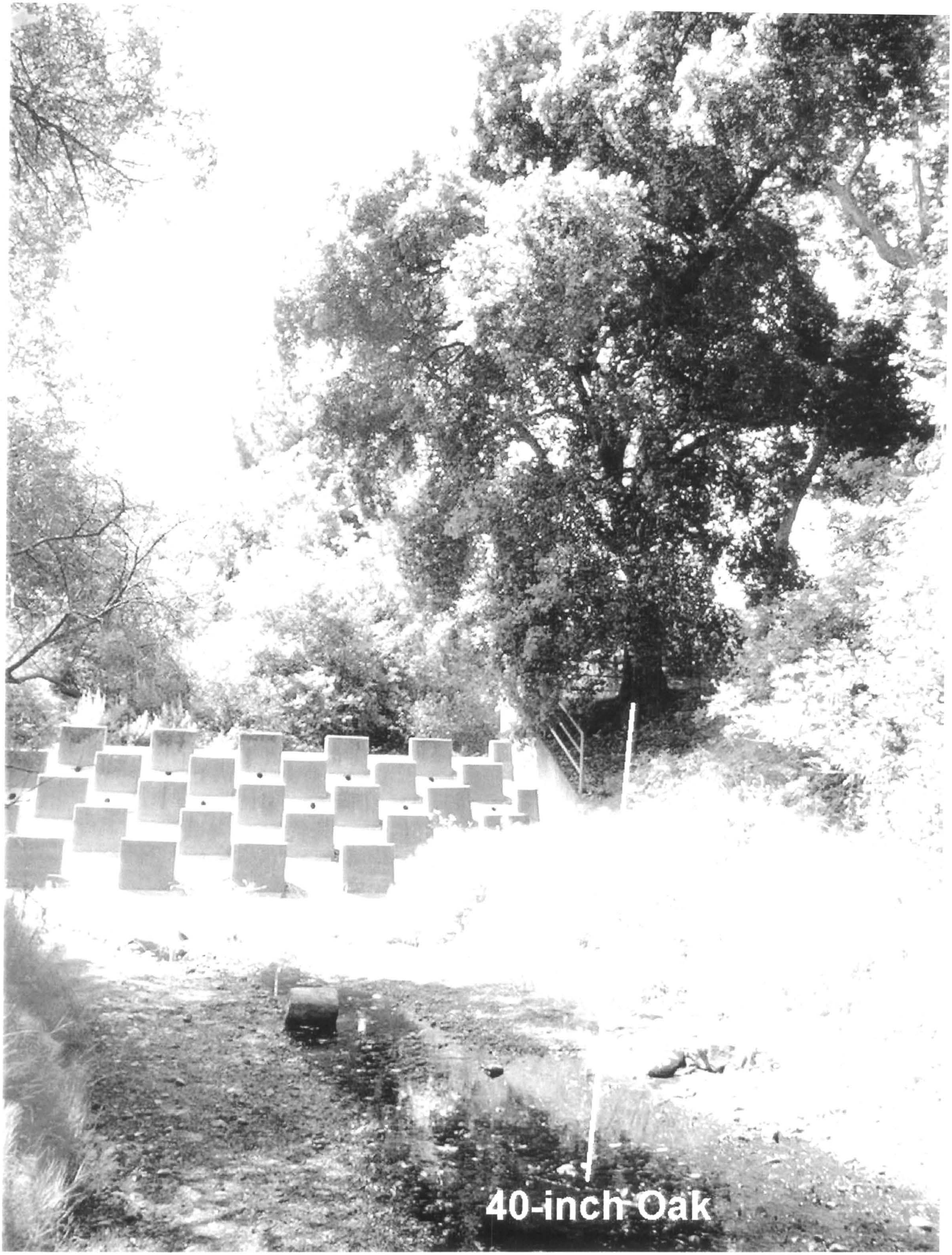
11/5/2001

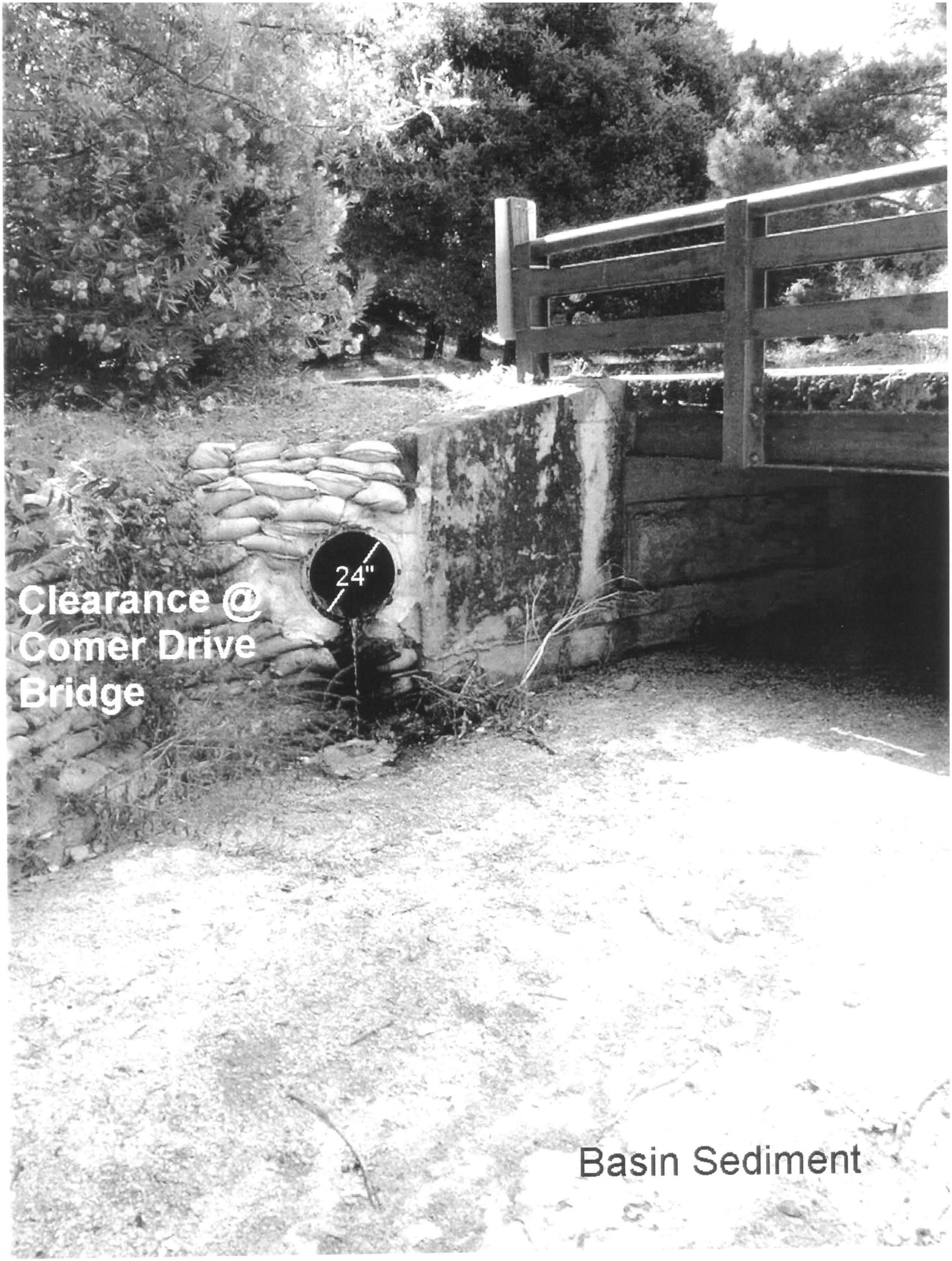
# Appendix H

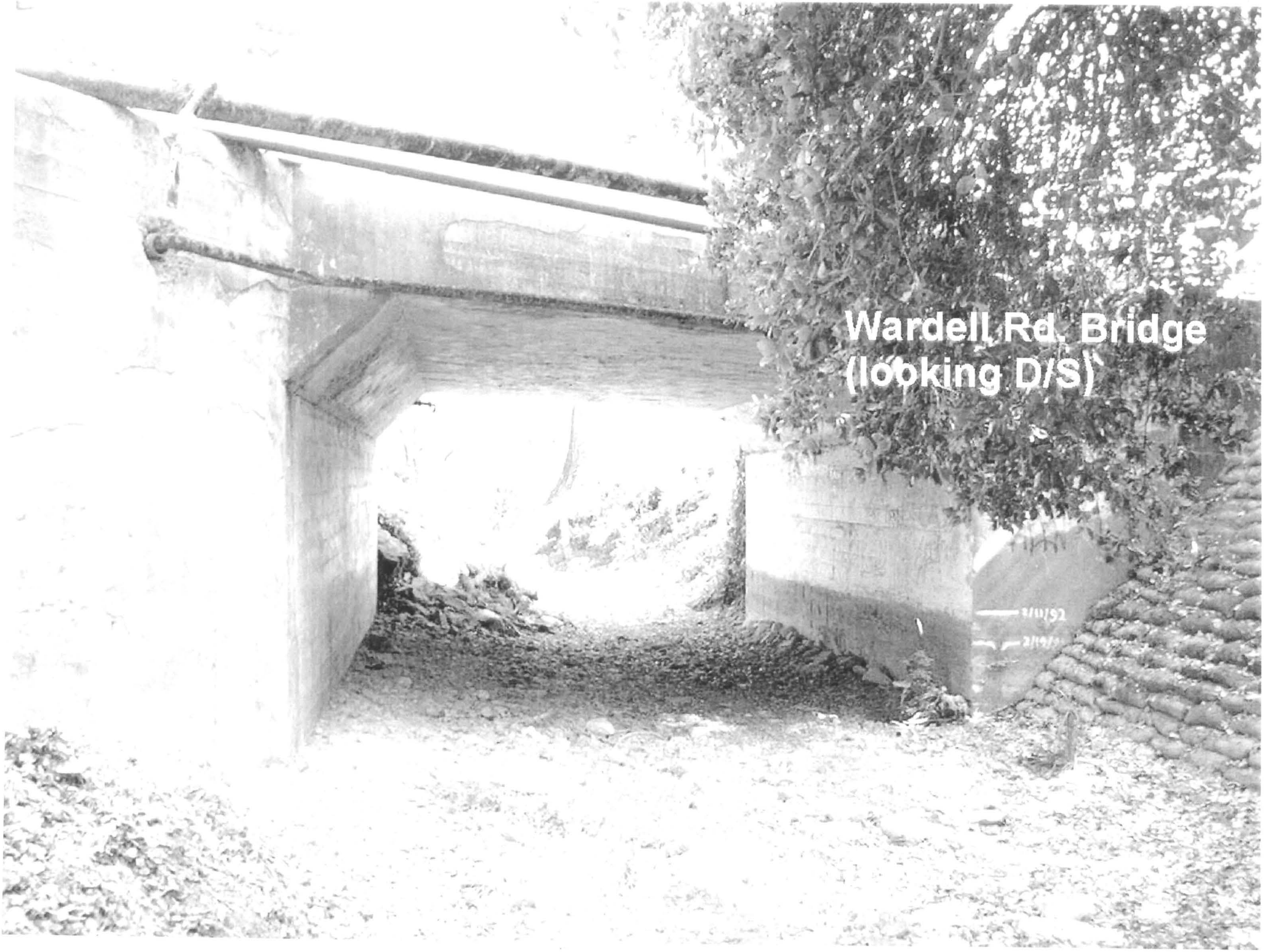
## PHOTOGRAPHS


Comer Drive Bridge
Comer Debris Basin

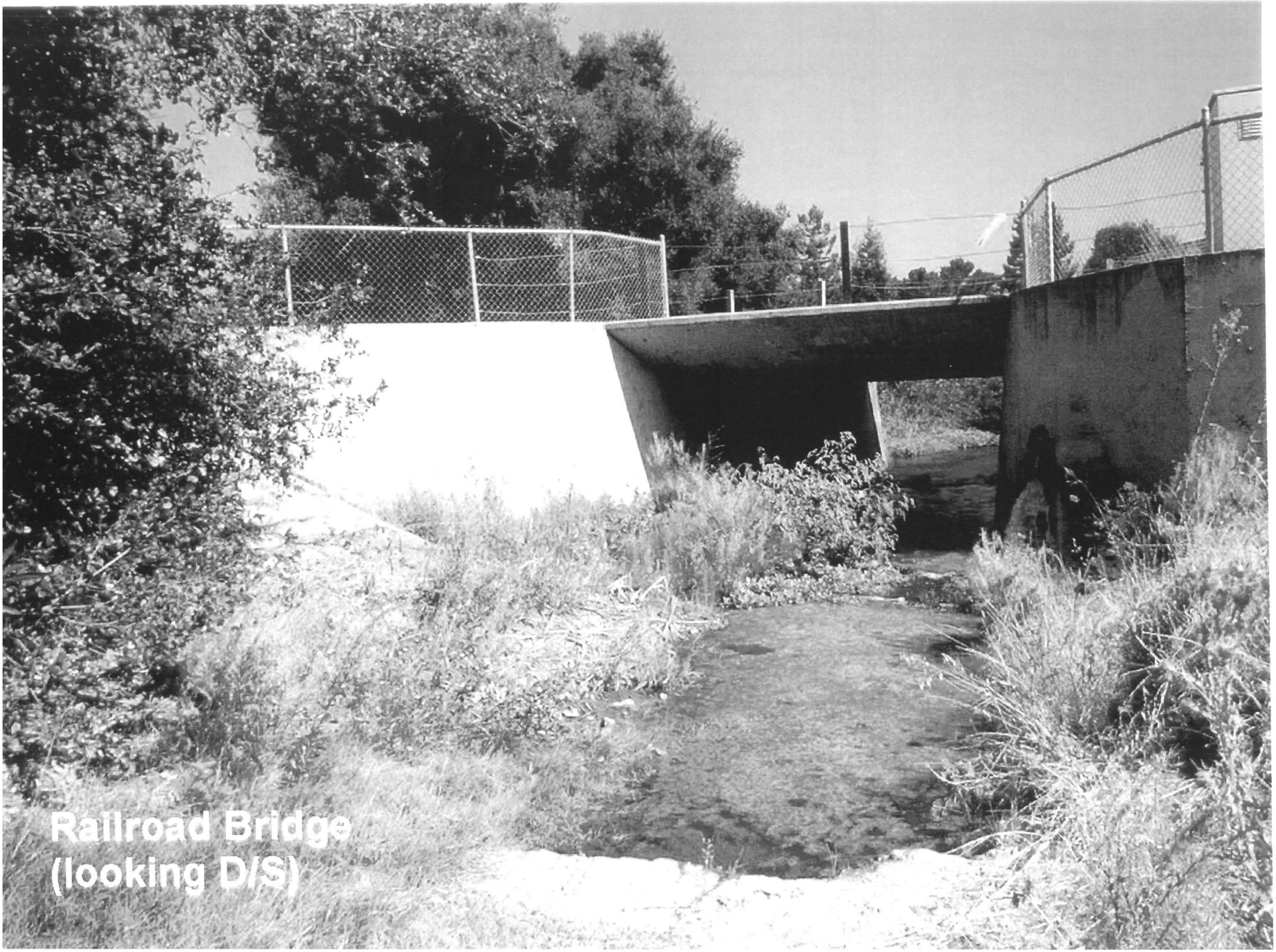

Basin Dam
(looking U/S)


40-inch Oak


24"
Clearance @ Comer Drive Bridge
Basin Sediment



Wardell Rd. Bridge
(looking D/S)


Railroad Bridge
(looking D/S)

# Appendix I

## ESTIMATES OF PROBABLE CONSTRUCTION COSTS

## TABLE I.1. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 2

**KENNEDY/JENKS CONSULTANTS**

**Project:** Comer Debris Basin Engineering Feasibility Study

**Building, Area:** Alternative 2, Headwall Demo, Uniform Slope

**Prepared By:** NEN/MHM
**Date Prepared:** 4/9/2002
**K/J Proj. No.** 015014.00

**Current at ENR**
**Escalated to ENR**

**Estimate Type:**
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

| Spec. No. | Item No. | Description | Qty | Units | Materials $/Unit | Materials Total | Installation $/Unit | Installation Total | Sub-contractor $/Unit | Sub-contractor Total | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | Planning: CEQA | 1 | LS | | | | | $60,000 | $60,000 | $60,000 |
| | 2 | Permitting | 1 | LS | | | | | $40,000 | $40,000 | $40,000 |
| | 3 | Pre-Design/Design/Constr. Support | 1 | LS | | | | | $150,000 | $150,000 | $150,000 |
| | 4 | Concrete Demo | 120 | CY | | | $400.00 | $48,000 | | | $48,000 |
| | 5 | Sediment Excavation | 11,500 | CY | | | | | $25.00 | $288,000 | $288,000 |
| | 6 | Stream Restoration/Reveg/Grading | 1 | LS | | | | | $250,000 | $250,000 | $250,000 |
| | | Subtotals | | | | $0 | | $48,000 | | $788,000 | $836,000 |
| | | Taxes | @ | 7.75% | | | | $3,720 | | $61,070 | $64,790 |
| | | Subtotals | | | | | | | | | $900,790 |
| | | Contractor OH&P | @ | 15% | | | | $7,200 | | $118,200 | $125,400 |
| | | Subtotals | | | | | | | | | $1,026,190 |
| | | Contingency | @ | 25% | | | | $12,000 | | $197,000 | $209,000 |
| | | Estimated Bid Cost | | | | | | | | | $1,235,190 |
| | | Engineering (see Item 3) | @ | 0% | | | | | | | $0 |
| | | Total Estimate | | | | | | | | | $1,235,190 |

Estimate accuracy is +50% to -30%

## TABLE I.2. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 3

**KENNEDY/JENKS CONSULTANTS**

**Project:** Comer Debris Basin Engineering Feasibility Study

**Building, Area:** Alternative 3, Headwall Demo, Stepped Channel

**Prepared By:** NEN/MHM
**Date Prepared:** 4/9/2002
**K/J Proj. No.** 015014.00
**Current at ENR**
**Escalated to ENR**

**Estimate Type:**
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

| Spec. No. | Item No. | Description | Qty | Units | Materials | | Installation | | Sub-contractor | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $/Unit | Total | $/Unit | Total | $/Unit | Total | |
| | 1 | Planning: CEQA | 1 | LS | | | | | $60,000 | $60,000 | $60,000 |
| | 2 | Permitting | 1 | LS | | | | | $40,000 | $40,000 | $40,000 |
| | 3 | Pre-Design/Design/Constr. Support | 1 | LS | | | | | $150,000 | $150,000 | $150,000 |
| | 4 | Concrete Demo | 120 | CY | | | $400.00 | $48,000 | | | $48,000 |
| | 5 | Sediment Excavation | 4,000 | CY | | | | | $25.00 | $100,000 | $100,000 |
| | 6 | Stream Restoration/Reveg/Grading | 1 | LS | | | | | $200,000 | $200,000 | $200,000 |
| | | Subtotals | | | | $0 | | $48,000 | | $550,000 | $598,000 |
| | | Taxes | @ | 7.75% | | | | $3,720 | | $42,625 | $46,345 |
| | | Subtotals | | | | | | | | | $644,345 |
| | | Contractor OH&P | @ | 15% | | | | $7,200 | | $82,500 | $89,700 |
| | | Subtotals | | | | | | | | | $734,045 |
| | | Contingency | @ | 25% | | | | $12,000 | | $137,500 | $149,500 |
| | | Estimated Bid Cost | | | | | | | | | $883,545 |
| | | Engineering (see item 3) | @ | 0% | | | | | | | $0 |
| | | Total Estimate | | | | | | | | | $883,545 |

Estimate accuracy is +50% to -30%

## TABLE I.3. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 4

**KENNEDY/JENKS CONSULTANTS**

**Project:** Comer Debris Basin Engineering Feasibility Study

**Building, Area:** Alternative 4, Partial Headwall Demo, Limited Excavation

**Prepared By:** NEN/MHM
**Date Prepared:** 4/9/2002
**K/J Proj. No.** 015014.00

**Current at ENR** 
**Escalated to ENR**

**Estimate Type:**
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

| Spec. No. | Item No. | Description | Qty | Units | Materials | | Installation | | Sub-contractor | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $/Unit | Total | $/Unit | Total | $/Unit | Total | |
| | 1 | Planning: CEQA | 1 | LS | | | | | $60,000 | $60,000 | $60,000 |
| | 2 | Permitting | 1 | LS | | | | | $40,000 | $40,000 | $40,000 |
| | 3 | Pre-Design/Design/Constr. Support | 1 | LS | | | | | $150,000 | $150,000 | $150,000 |
| | 4 | Concrete Demo | 16 | CY | | | $400.00 | $6,400 | | | $6,400 |
| | 5 | Sediment Excavation | 1,600 | CY | | | | | $25.00 | $40,000 | $40,000 |
| | 6 | Stream Restoration/Reveg/Grading | 1 | LS | | | | | $100,000 | $100,000 | $100,000 |
| | | Subtotals | | | | $0 | | $6,400 | | $390,000 | $396,400 |
| | | Taxes | @ | 7.75% | | | | $496 | | $30,225 | $30,721 |
| | | Subtotals | | | | | | | | | $427,121 |
| | | Contractor OH&P | @ | 15% | | | | $960 | | $58,500 | $59,460 |
| | | Subtotals | | | | | | | | | $486,581 |
| | | Contingency | @ | 25% | | | | $1,600 | | $97,500 | $99,100 |
| | | Estimated Bid Cost | | | | | | | | | $585,681 |
| | | Engineering (see item 3) | @ | 0% | | | | | | | $0 |
| | | Total Estimate | | | | | | | | | $585,681 |

Estimate accuracy is +50% to -30%

# Table I.4
# Comer Debris Basin Feasibility Study
## Engineer's Conceptual Estimate of Probable O & M Costs

| O&M<br>Costs | Unit | Alternative<br>2 | <br>3 | <br>4 |
|---|---|---|---|---|
| Crew Rate[1] | day[2] | $ 2,720.00 | $ 2,720.00 | $ 2,720.00 |
| No. of Visits/Year[3] | | 2 | 4 | 2 |
| Subtotal Maintenance | | $ 5,440.00 | $ 10,880.00 | $ 5,440.00 |
| Biology/Habitat Monitoring[4] | day[5] | $ 760.00 | $ 760.00 | $ 760.00 |
| No. of Visits/Year | | 12 | 12 | 12 |
| Subtotal Monitoring | | $ 9,120.00 | $ 9,120.00 | $ 9,120.00 |
| **Total Annual O & M** | | **$ 14,560.00** | **$ 20,000.00** | **$ 14,560.00** |

Notes

1) Maint. crew assumed to consist of 4 personnel @ $85/hr ea.(incl overhead) w/2 pickups, tools.
2) Assume an 8 hour day for each maintenance visit
3) Alt. 3 - Assume 1 visit/mo April - Oct, and two visits/mo Nov-March
4) Monitoring crew assumed to consist of single biologist @ $95/hr (incl overhead).
5) Assume 8 hour day for each monitoring visit, including report prep.